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The Oldest American Aeronautical Magazine

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Leslie E. Neville
Managing Editor

S. Paul Johnston
Assistant Editor

David J. Leisk
Art Director

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Edward P. Warner, *Editor*

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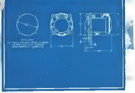

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AVIATION
FOR OCTOBER, 1933

Airlines, with problems of safety and passenger comfort well in hand, now turn the spotlight on operating details and especially on economies that might once have appeared insignificant. Out of a long experience in airline operations and airplane manufacture, Mr. Kirchner calls attention to a few practical matters which, if neglected, may add to the costs of engine operation.

Economies of engine operation

Notes on warm-up and idling time, with some observations on the proper use of tail winds

By O. E. Kirchner

SEEKING profits in air transportation, air line executives are diligently searching for practical economies in the operation of aircraft engines, an item which constitutes approximately 52 per cent of the direct operating costs. Engine manufacturers have co-operated by building engines of higher compression ratios, yielding more miles per gallon from the modern high-octane-number fuels. Airplane designers, by means of super-streamlining, have furthered the economy of engine operation by marked reduction in unprofitable parasite drag. Further economies are necessary, however, and alert operators are beginning to see possibilities for cost reduction by making every engine hour a revenue-producing hour.

One source of engine expense is warming-up and idling time, an item which until recently has never been given much thought, for methods for determining such costs have not been definitely established. Until a few years ago it was common practice to warm up and idle engines for 30-40 minutes or more—apparent necessity overshadowing the actual costs involved. It was essential, first, to obtain actual records of the number of minutes the engine operated—for warming-up, for idling, and in flight. A Hasler Tel Record Tachometer was installed on one of the outboard engines of a Fokker F-10 Airplane, and records taken from many flights from several airplanes over the route under investigation. It was thus possible to determine the time and revolutions for warming-up, the exact moment of full throttle run-up, the time and r.p.m. of idling, and the time and r.p.m. while in flight. The study was made during a period of two months.

A study of the records showed that the ground time was equivalent to 14 per cent of the engine flight time (6.3 per cent for warming-up and 7.7 per cent for idling). Idling time includes such time at intermediate stations where the engines are allowed to run while unloading and loading mail express and passengers.

Getting down to cases

The contributing factors which make up the cost of warming-up and idling operation and their proportional share of the total hourly cost for an actual case are given below. The figures given are for a Wasp B 420-hp. engine and are based on the assumptions that:

(a) The wear and tear of an aircraft engine in flight at cruising is directly proportional to the number of revolutions of the engine crankshaft.

(b) The wear and tear of an aircraft engine in warming-up and idling is proportional to the square of the r.p.m. multiplied by a factor 1/2 to account for the reduced wear at low speed operations.

(c) The life expectancy of aircraft engines varies from 2,100 to 3,500 flight hours depending on the particular aircraft operator. For this study the life expectancy was taken as 3,000 flight-hours.

(d) The warm-up revolutions assumed as 1,000 per minute.

(e) The idling revolutions assumed as 500 per minute.

(f) Mechanics labor is included in warming-up, the pilot is assumed at the controls at all times in idling. (This is not necessarily true but is conserva-

tive and simplifies the cost determinations)

(*g*) The cost of a 420 hp engine is assumed as \$5,500, overhaul costs as \$350, with overhaul periods assumed at 350 hours

In the following method for determining depreciation charges a new unit, which, for want of a better term, we shall call the "equivalent wear and tear revolution," was used as a measure of wear and tear Based on the above assumptions, the total number of equivalent crankshaft wear and tear revolutions in the life of an engine are shown in Table I

The depreciation cost per "equivalent wear and tear revolution" becomes

$$\$5\,500.00 \div 5\,320\,500 = \$0.001035$$

The warming-up depreciation cost per hour of warming-up time is

$$1\,000 \times \frac{1\,000}{2 \times 1\,750} \times \$0.001035 = \$.30$$

Then, idling depreciation cost per hour of idling time

$$500 \times \frac{500}{2 \times 1\,750} \times \$0.001035 = \$.07$$

By following a similar method of analysis and substituting hours and costs per overhaul the reserve for overhaul was determined. It was found that these costs for warming-up and idling were respectively, \$.16 and \$.04 Having the depreciation and overhaul costs, we are now in a position to determine the total hourly costs involved in the operation of warming-up and idling as shown in Table II

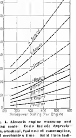


Fig. 1. Aircraft engine warm-up and idling costs Costs include depreciation, overhaul, fuel and oil consumption, and mechanic's time Solid lines indicate idling periods, dotted lines, warm-up

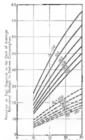


Fig 2 Effect of unestimated tail winds on fuel consumed S_c = cruising velocity (ground speed) in m p h All data at sea level conditions Solid lines indicate possible reduction in fuel required between stations if engines are throttled to hold normal schedules Dotted lines indicate reduction in station-to-station fuel consumption if recommended normal cruising r p m is maintained

For one year's operation, assuming 1 000 flying-hours per plane, the cost of warming-up and idling was determined (from Table II) as follows

Warming-up	.063x1 000x4 98 =	\$313 74
Idling	.077x1 000x1 68 =	129 36
		\$443 10

Perhaps the depreciation and reserve for overhaul charges are too severe a tax for the operations being studied but omitting these factors will still give a total of \$330 75 per year for warming-up and idling the type of equipment under investigation—a surprising figure and one which justifies considerable thought.

In view of these preliminary findings, definite rules were at once put into effect on the route in question while further studies were continued for the elimination of all idling and considerable reduction of the warming-up periods These regulations were (1) at terminals—elimination of all idling after warm-up, (2) at intermediate stations, the engines to be cut in all instances where idling periods would extend over four minutes, except at such stations as were not equipped with starting equipment, (3) use no more time than necessary for warming-up

Objections to the above analysis were anticipated on the basis that ground time is not accumulated with flight time for determining overhaul periods However, the determination of the proper overhaul period is governed by wear and tear of the engine, and the reduction of idling and warming-up causes contributing to wear and tear automatically lengthens out the overhaul period. The present method of engine time determination is only used for convenience in accounting

Excessive ground operation is not only costly, but it leads to spark plug fouling, and idling below definite speeds is discouraged by the engine manufacturers, who fear lack of lubrication of certain parts of the engine at low speeds. As far as warming up is concerned it has been determined from experience that as soon as the oil is sufficiently fluid, as indicated by the pressure gage, the engine is ready for the run-up to cruising r.p.m.

The problem of accelerating the rate of engine warm-up is being attacked in two ways The first is by preheating the engine by electrical heating units or other means. One method suggested by a maintenance foreman consists of incorporating in the original design of the airplane power plant unit a double-jacketed oil tank so constructed that heated air could be forced between the outer jacket and around the main tank Some such system might be used economically well into the summer season as it would reduce the starting wear and tear in addition to reducing the engine warm-up time

The second is in preheating the engine unit. Various attempts have been made in this direction with satisfactory results One maintenance foreman built a canvas duct by means of which heated air from the hangar heating system was forced to and around the engine (See AVIATION, June 1932, p 282) The plane could almost be pushed

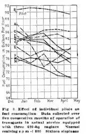


Fig 3 Effect of individual pilots on fuel consumption Data collected over five consecutive months of operation of transports in actual service equipped with three 420-hp engines Normal cruising r p m -1 800 Sixteen airplanes eleven pilots involved

Table I*

		Real Revolutions		Equivalent Wear and Tear
Cruising 5 000x1 750	=	5 250 000x1	=	5 250 000
Warming-up 3 000x .063x1 000	=	$189\,000 \times \frac{1\,000}{2 \times 1\,750}$	=	54 000
Idling 3 000x .077x500	=	$115\,500 \times \frac{500}{2 \times 1\,750}$	=	16 500
Total				5 320 500

*To reduce the magnitude of the totals the factor 60 has been omitted throughout the calculations.

Table II Summary: For One Engine

	Warming-up	Idling
Depreciation	\$ .30	\$ .07
Reserve for overhaul	.16	.04
Fuel consumed 8 gal @ 1 800 r p m @ 10 cents per gal	.80	
Fuel consumed 3½ gal @ 500 r p m @ 10 cents per gal		.35
Oil consumed 1 qt @ 10 cents per qt	.10	.10
Total except for labor, for one engine	\$1 36	\$ .56
For three-engine installation	4 08	1.68
Labor @ 60 cents per hour and 50 per cent overhead	.90	
Total cost for three engine installation	\$4 98	\$1 68

out of the hangar and the throttles immediately opened out full

Reduction of idling time is being accomplished by the installation of electric-starter equipment on all engines, and it is now not an unusual sight to see an airplane taxi to the loading ramp and cut engines until ready to go By cutting the engines the pilot can leave the airplane to assist in clearing for the next station. The co-pilot or mate may then supervise the loading of mail and express and lend assistance to passengers Anxiety on the part of the station manager in keeping people away from the revolving propellers is also eliminated

For those who wish to determine the costs of warming-up and idling for power units other than the one discussed above, Fig 1 has been calculated for as high as four power units per airplane It is assumed that each unit has equal power specifications

Consider the tail wind

The formation of airplane schedules taxes the ingenuity of the transport operator Of the many factors which influence the final schedule, perhaps the most elusive is the determination of the proper wind allowance to yield a high percentage of schedules made good. It is not sufficient to determine the strongest adverse wind likely to be met with, based on past meterological records (from the *Monthly Weather Review* of the Department of Agriculture), since this would obviously result in an uneconomical cruising speed. It is common practice to base schedules on average wind conditions over a period of time

In many parts of the country it is necessary to change schedules because of seasonal shifts in prevailing winds After a schedule has been determined the pilot is required to hold it within the operating limits of the aircraft In the event of adverse winds greater than those allowed in the schedule the pilot is challenged to try to hold his schedule and at the same time not to exceed his maximum allowable operating conditions In most cases an unavoidable delay results

In the event of favoring winds, unforeseen in the schedules, the pilot may operate at normal cruising speed and arrive ahead of schedule or he may throttle down to arrive at his destination on schedule Operators in general discourage arrival at a station considerably ahead of time since it usually necessitates a lay-over for departure The general rule is to request pilots to throttle engines to balance out the additional wind factor and thereby obtain certain fuel savings

Operating at normal cruising r p m the reduction in fuel is a function of the reduction in scheduled time in flying between two stations and can be expressed by

$$\frac{W}{S_e \pm W}$$

where W = algebraic difference between the wind allowance in schedule and actual favorable wind on day of flight (that is if normally the schedule allows an adverse wind of 5 m p h and there exists on the day of flight a favorable wind of 5 m p h then W = 10)

and S_e = normal cruising speed of airplane corrected for schedule wind allowance (the scheduled ground velocity of the airplane)

This expression is plotted in Fig 2 for an airplane with scheduled ground velocities varying from 100 to 200 m p h and for excess unscheduled favorable wind velocities varying from 10 to 40 m p h. along the flight path of the airplane.

This fuel reduction is only a part of what is possible by throttling the engine or engines The fuel consumed with change in throttle position for several airplanes was found to vary approximately as the $(\text{speed})^{2.76}$; from this it can be shown that the reduction in fuel required in per cent between two stations when throttling the engine or engines becomes

$$1 - \left[\frac{S_e - W}{S_e}\right]^{1.76}$$

A study of Fig 2, on which this expression has also been plotted, will indicate the extent of fuel consumption reductions derived from unscheduled tail-winds It is of course obvious that such engine throttling should not be carried beyond adequate airplane control and passenger comfort.

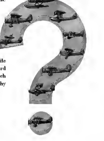
A careful study of fuel consumption can serve as an index of pilot efficiency That differences exist in the way pilots operate airplanes is shown graphically in Fig 3 in an analysis of fuel consumption over a six-month period of eleven pilots using the same type of equipment The points on the chart were obtained by taking the average of the fuel consumption of two adjacent months throughout the period under investigation No particular airplane of the sixteen in the group studied was assigned exclusively to any particular pilot The data are remarkable for the consistency of the fuel consumption for any one pilot for the period investigated They show also the opportunity a pilot has for regulating this important factor in the direct operating costs of the airplane Considering that the difference between the minimum and maximum as shown on the chart is approximately 25 per cent of the fuel consumption of the airplane, it is clear that savings could be obtained by emphasizing to the pilots the importance of taking advantage of every favorable circumstance Expressed in dollars and cents, a 25 per cent saving (18 gal per hour @ 10 cents per gal) would amount to \$1 80 per hour which is well worth while going after

The history of transportation in other fields confirms the fact that study of the detailed operation of equipment can be a fertile source of savings. Bus and traction companies have found it well worth while to stimulate interest in economies by means of bonuses based on fuel or power saving The power required, or the fuel used for each unit of rolling stock is automatically recorded and used as a basis for the granting of special compensation The time is not too far distant when each transport airplane will be equipped with recording barograph and tachometer as a means of encouraging more economical aircraft operation

A designer studies the basic requirements for the ultimate airplane for the private owner

Search for an ideal

(PART I)



Airplane manufacturers, overlooking entirely the example set by automobile makers, have shown little tendency to tread a common path toward a standard arrangement of essential units Mr. Huntington, in three articles (of which this is the first), takes apart a set of ideal specifications and builds up step by step a picture of the airplanes of the future

By Dwight Huntington

AFTER 28 YEARS of airplane development, few of the several major considerations affecting the general design of a ship have been definitely and unanimously agreed upon by the dominant manufacturers As a result, any group of planes of similar size and for the same purpose often differ widely in seating arrangement, type and placing of power plant, wing and landing gear plans, pilot's outlook, and so on

Omitting from present discussion the autogiro (which has already appeared in tractor and pusher types), it is evident that progress in airplane design during the past two decades has been largely a matter of improvements in detail and increase in size A quest for the prototypes of many present-day planes will lead back to such dissimilar types as the Bleriot XI monoplane of 1909, the Goupy staggered wing biplane of 1910, and the 1911 Antoinette—a full cantilever monoplane with pantalette undercarriage

Other types in use are combined forms such as the application of cantilever monoplane wing design to the Dunne headless and tailless principle of 1910, then in biplane form Similarly, so-called "new" ships of the canard variety have offered little more than a rehashing of basically old units—power plant, fuselage, wings, and landing gear—around a design principle which antedates the industry

Of course it is not my intention to belittle the real design progress that has been made, but rather to direct attention to the fact that there has been no persistent evolution of one preferred type of airplane, in any of the numerous purpose classifications

The fact that an airplane incorporates either four or five units influencing the general design, as compared with three for the auto and two for the motor boat, and that each unit of the plane is capable of a much wider variety of interpretations than those of the other vehicles mentioned has been partly responsible for the inability of designers to agree upon the best arrangement of the essential units Considerations such as resistance and weight, vision, and propeller location crowd plane designers more than they do auto and motor-boat designers, adding materially to the problems of general design and finally to the number of airplane types

One underlying cause of the chaotic condition in evidence is found in a failure to buckle down to the several fundamental considerations influencing plane design Optimum vision is a typical example. There can be but one best series of vision angles for a ship for a given purpose, yet probably no two designs afford identical angles of vision

Certainly not every one of the several types of ships in a given class can be considered as ideally suited to a particular purpose For a given service and price, we might expect to find but one best type of plane The presentation of numerous types indicates a lack of definite sense of direction Many designers are in a quandary, and some of them appear to be traveling in circles

Although recent economic conditions have driven most of the ouija-board designers under cover eliminating at least for the present the unfavorable influence of amateurish designs upon sales, the "hunch" brand of design is still in evidence here and there In unfortunate attempts to discover something that would strike the public fancy squarely, many plane designers have juggled the same old units until the audience got tired of watching and went home

The automobile industry

The adverse effect of the multiplicity of types upon airplane sales becomes more readily apparent by contrast with the automobile industry For more than two decades automobile manufacturers have marched together in the general design of their products and it is reasonably certain that their phalanx-like advance has stimulated public confidence in motor cars and played an important part in the rapid growth of that industry By enabling people to visualize the approved type of motor car, whether priced at $500 or $5,000, manufacturers have presented prospects with an excellent assurance of the value and correctness of design of all automobiles—in itself a subtle invitation to the salesroom

The airplane prospect on the other hand is confronted with a variety of types, and arguments advanced for each tend to confuse and discourage him If he examines all types offered within his chosen purpose classification, numerous questions will present themselves How many wings? Should the tail be out front or drag behind? Where is the proper location for the propeller? Should the engine be in front or behind, overhead or underfoot?

Early automobile engines exhibited nomadic tendencies, being found now in front, then in the rear, and occasionally in hiding under the seat, but manufacturers quickly sensed the commercial advantages of design uniformity and since then have been riding their individual hobbies on the testing track, not offering them for sale

The dissimilarity in airplane designs is not confined to the small sizes, however, but extends throughout the entire range The patron of an air line can only guess what type of ship he will ride in. Passengers of bus, railway and steamship lines however, know beforehand the appearance of their carriers, because their general forms are already a part of every day experience

The unpleasant truth of the matter is that the aeronautical industry is still in the pageant period of its growth The industry cannot tell the public what the next floats will be like

Selling air travel

Selling a new method of transportation—and air travel is still new to a very large majority—is a two-fold problem The confidence of the public must first be secured by emphasizing the advantages and safety, and secondly, adequate value must be offered The industry must convert the public before the manufacturer or operator can sell the individual

As matters now stand manufacturers collectively are spending money to convert the public to flying, but separately are traveling divergent design paths, thereby nullifying some of the effects of their joint efforts As long as airplane manufacturers themselves remain unsure as to the direction in which they are leading, they can have no just grounds for lamenting the fact that people are not following them with enthusiasm

Airplane manufacturers and operators could profit by the examples of design uniformity set by other methods of transportation They should realize that many of the types of planes in use today are psychologically and economically unsound, and pool their design resources to present a united front to the public concerning the particular combination of units which comprises the ideal airplane for each particular purpose Designers collectively would then find it necessary to abolish faddism and get down to design fundamentals, to reach a general agreement on considerations of loadability, flight characteristics, vision and so on, for each purpose classification, to apply impartially each yardstick thus obtained to all designs, past and present. It would then be possible to retain meritorious features and consolidate past gains, to thrash out with some confidence in finality all the numerous differences that have thus far delayed the standardization of aircraft types Combining the results into an ideal or representative type in each purpose classification, the design specifications for which have been dictated solely by a thorough analysis of commercial requirements, would strengthen public confidence in aircraft generally. Manufacturers would enjoy a more profitable evolutionary progress. Each would offer the market his individual interpretation of the representative product. Manufacturers of inferior types would soon be obliged to standardize or retire

A study in design contrasts from an earlier day

Left: The Curtiss pusher of the vintage of 1909 offered little protection to the pilot, but afforded practically unlimited vision Above: A tractor triplane by A. V. Roe of about the same period exhibited one of the earliest fully enclosed fuselages Above right: Seated on the cross axle of the undercarriage Santos Dumont takes off in one of his tiny "Demoiselle" monoplanes

from the field. Now is the opportune moment for the industry to take a long forward stride toward type determination in order that the upswing of the airplane manufacturing business may be accelerated by the appearance of ships that inspire unhesitating confidence on the part of the public

A broad investigation

To be of maximum value a design investigation should be conducted thoroughly and impartially along very broad lines A good beginning might be made by obtaining from the most capable and experienced pilots of the world (by questionnaire) a concensus of opinion on such questions as optimum vision and controlability Operators and owners should contribute liberally to the fund of desirable attributes and thereafter it would devolve upon designers, assisted by engineering, manufacturing and maintenance men, to evolve the representative types of tomorrow's airplanes

It is highly probable that soon after the findings of a competent design committee were made known the manufacture of certain present types would be discontinued Moreover, radical design innovations outside of the representative types thereafter would be relegated to the proper status of experimental designs instead of immediately entering upon the market as "radically improved" airplanes, to confuse the public and thus unjustifiably detract from the merits of more capable group design. The industry would thus relieve patrons and prospects of the present burden of determining what constitutes a fundamentally good airplane All too frequently meritorious designs have been compelled to compete with second and third raters for the scanty patronage of an unguided public

The purchasers' viewpoints

In buying airline flying stock the purchasing agent has a definite duty to perform and therefore utility is the first consideration Safety and economy rate second and third respectively, since an unsafe airplane might easily prove very costly, even as a gift.

The individual prospect has a different viewpoint If well-to-do, he will probably rank safety as the paramount consideration for the private airplane is, and for some years will be, essentially a pleasure craft Utility and economy therefore will be relegated to subordinate positions. When the prospect is of modest means, however, economy may displace safety as the initial consideration

Obviously if aircraft are to compete with all other carriers of noteworthy speed, from motorcycles to steamships, the number of purpose classifications will be large Each classification however, must in time evolve its representative type and to that end must receive individual attention.

The following search for a representative type (Parts II and III) centers upon the small private plane of sizes comparable to private motor cars with seats for two to seven passengers. Because it is merely a one-man quest, confined within limited space, it is necessarily somewhat sketchy The underlying motive however, is not an attempt to point out the ideal type, but rather to suggest a plan of procedure toward the attainment of that end, and to create interest in a topic of great financial importance to the industry

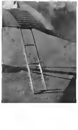
Since the history of automobile engineering is replete with examples of improvements that have been first incorporated in high-priced machines, later descending to the lower brackets, the problem of economy is here ignored. Once the ideal outline for an airplane has been evolved, production men may be depended upon to effect drastic reductions in manufacturing cost, with an increased demand—the probable result of group design—as a strong incentive.

The designer's burden

OF LATE YEARS the poor airplane designer has been staggering along under an ever increasing burden of extra weight demanded by operators of transport planes both for economies in maintenance and for the comfort and convenience of passengers We have repeatedly called attention to the maintenance factors in these pages and pressure of opinion from the air-traveling public has made improvement in comfort almost mandatory It hasn't been so many years since a passenger was supposed to sit in a bucket seat in a windy cockpit and like it, but, for better or for worse, "Those days are gone forever." The extras that have been provided on the new Boeing 247 transports give a good indication of the present state of affairs from the designer's viewpoint The weight per passenger of conveniences have been listed as follows baggage, 30 lb , reclining seat and safety belt, 19 lb , laminated safety window glass, 4 4 lb , sound proofing and cabin insulation, 16 3 lb., lavatory and equipment, 4 4 lb , ash trays, coat and hat racks, steps, service call system etc 22 6 lb , stewardess and her equipment, 28.8 lb Obviously, the only way out of the dilemna is to offset these extra weights by continuous improvement in aerodynamic and structural efficiency

Built-in gang plunk

ONE of the novel features built into the cabin giro recently delivered by Pitcairn Autogiro Company to the Florida Year-round Clubs for taxi service at Miami (see AVIATION, March 1933, page 99), is a built-in stepladder to give quick and easy access to the cabin door Built of tubular dural for lightness and strength, it is mounted in a pocket on the under side of the wing stub on the left-hand side When not in use it is completely enclosed within the wing. To operate, it is only necessary to reach into a small slot in the underpart of the trailing edge, lift the lowest round slightly to unlatch it, pull it out full length, and allow the free end to drop to the ground Reversing the process is equally simple the free end is raised so that the ladder is in horizontal position, and it is then pushed forward into its receptacle With a device of this sort on board, the loading and unloading of passengers is made entirely independent of outside steps



Left: Built-in ladder of Pitcairn cabin giro in fully extended position. Above: The ladder partly withdrawn.

The airlines see their new charter of self-government through the public hearings

Coding air transport

THE public proceedings of the National Recovery Administration have a placidity that is in odd contrast to the furious turmoil that rules in the NRA offices. In the Department of Commerce Building, Deputy Administrators and the like work eighteen hours a day and anxious deputations of business men receive appointments to call and thrash out the perplexities of their respective codes at any hour up to midnight But when the codes are put on dress parade and the contending factions are given the chance to speak their pieces in public, the NRA official who presides holds controversy within the strictest bounds and allows nothing that sounds like direct argument There is no cross-examination Each witness makes his statement, supposed to be limited to the presentation of facts, and departs in peace. The real debates come later

That is, at least, the general theory It does not always work out exactly according to plan When the Air Transport Code was heard on Aug 31 there was no cross-examination of witnesses but there was plenty of argument submitted Fiorello H LaGuardia ex Congressman and ex-Major in the Air Corps, was on hand as advocate for the airline pilots, and there is no such thing as a LaGuardia speech without argument or without fire No check was put upon his eloquence and the hearing was both livelier and longer than most of those that have been held for other industries.

Malcolm Muir spoke for NRA

Malcolm Muir, deputy administrator in charge, presided With him at his long table at Frederick W Coburn, former president of the Aviation Corporation and of American Airways, and the deputy's general advisor on behalf of the industry, Edward G Hamilton, former airline pilot, now Washington representative of the Airline Pilots' Association and chosen by the NRA Labor Advisory Board as the general labor advisor on this particular code Earl E. Hughes, once advertising manager of Curtiss-Wright Corporation and now assistant deputy administrator in the NRA, with special responsibility for the development of the transportation codes and representatives of various departments of NRA, such as the legal division and that which coordinates the codes and avoids any conflict in their provisions Facing the long official table in the Hotel Mayflower ballroom were some twenty witnesses and some 50 spectators, including the presidents of four of the major airlines and official representatives of a number of others

One of the four presidents, Lester D Seymour of American Airways, appeared as first witness to present the code for the operators. Testifying in his opening statement to the transport operators interest in the NRA program and to their eagerness to contribute to its success, he pointed out that air transport differed from almost all other industries in one very important fashion, —in that no re-employment problem exists Progress has been steady, and figures show an unbroken increase in the number of wage earners in air transportation in the United States, from 2 345 in 1929 to 4,290 in 1931 and 5,997 on July 1 of the present year

The growing traffic, passenger, mail and express, was cited as evidence of growing public interest, but the NRA and all others concerned were warned against misinterpreting the significance of growing passenger figures The air mail payments Mr Seymour reminded his audience are the backbone of the industry For the major air transport companies they constitute from 60 to 80 per cent of the total revenue received Those payments being fixed or steadily declining the ability of the airlines to assume new obligations as an incident to a general rising price level and increase of business activity is limited "If our operations under the National Recovery Administration are to mean additional expense disproportionate to the ability of our companies to pay many of our companies will be threatened with extinction, or at lest with severe curtailment of operations in order to conserve their remaining resources"

From that introduction he dived into the vexing question of the salaries of pilots, where most of the code's potential fireworks obviously lay He flatly declared that there was no idea that the suggested minimum rate of $250 a month for pilots should be considered as establishing a prevailing rate. He pointed out that on the major air lines the salaries of pilots now ranged from $6 000 to $11,000 a year He expressed much doubt, in fact, of the propriety of treating the individuals in such a salary range under the National Recovery Act, which was interesting in view of the later argument from Mr LaGuardia that all mention of the pilots should be eliminated from the code Mr Seymour explained the proposed minimum guarantee of $250 a month for airplane pilots as having been "fixed with consideration for the smaller operators, at least one of whom now pays his pilots as low as $100 a month"

Then, too, the existence of a low minimum wage would permit the creation of entirely new services, such as the transport of freight at low rates, and so would result in employment for more pilots than could be taken care of if very high salaries were to be standardized So far as the persistent argument over the relative merits of hourly pay and mileage pay is concerned, Mr Seymour merely remarked that a majority of the mileage flown for the last two years had been on the hourly or flat monthly basis

Concluding with a further summary of the general problems of air transport particularly those arising out of its close relation to the government and its dependence upon the Post Office Department for revenue, Mr Seymour referred to the trade practice provision that no new direct competition should be instituted over routes already served He found that "necessary during this period of pioneering and development because of the high percentage of revenue which the airlines receive from

the government. The operators considered that to permit two companies, drawing payment from the Post Office Department for the carriage of mail, to operate over one route in competition would not constitute a proper use of government funds."

As the paragraph-by-paragraph presentation of the code proceeded, following on Mr. Seymour's preliminary statement, the first opposition witnesses appeared on the section dealing with wages. The code provided a minimum of $20 per week for ground radio operators. Mr Haddock, representing a radio operators' association, suggested that that figure be changed to $200 a month minimum, with progressive increases up to $250 a month for a chief operator If any other function such as co-piloting, were combined with radio the employee concerned would get double pay In accordance with standard NRA rule these statements and all others were received without allowing any rebuttal. Presumably Mr Haddock's proposals aroused no enthusiasm in his hearers who are trying to find ways of making air transport break even financially but they offered no comment.

Close on the heels of Mr. Haddock came Fred Hewitt, representing the aircraft mechanics, with proposals not very different from those of the radio operators. Mr. Hewitt suggested a minimum of $225 a month for first class mechanics, $175 a month for second class, and $140 for third-class, who would probably not be holders of Department of Commerce licenses He offered a working week of 35 hours, almost identical with what Mr Haddock had proposed for the radio personnel And then LaGuardia was called

Mr. LaGuardia, though vigorous in his speech, was less pyrotechnic than some of his hearers had anticipated. He was not interested in a mere increase of the proposed minimum wage for pilots and co-pilots, nor in a mere reduction of the proposed hours He ridiculed the figures that were mentioned both for hours and wages, but what he really sought was the complete elimination from the code of all mention of pilots and co-pilots, first upon the theory that they were already under full federal control through the Department of Commerce, and second because as professional men they did not belong within the proper scope of the NRA He believes in commercial aviation and he believes that its success depends upon its personnel (Here the operators would be in full agreement). To train a transport pilot cost from $5000 to $10,000, and the purpose of "subsidizing" the industry, so Mr. LaGuardia flatly declared had been to build up a national defense and reserve personnel

Imploring in his peroration that air transport should follow the new thought toward the new light avoiding the old mistakes of the railroads, Mr LaGuardia concluded his presentation and stood aside for David L. Behncke, president of the Airline Pilots' Association, who suggested that the code authority should be replaced by a planning and co-ordinating and conciliating committee having three members each from the NRA, the Aeronautical Chamber of Commerce, and the American Federation of Labor. He farther urged that there should be a joint committee of representatives of the operators and of labor on every division to pass on questions of seniority and competence of personnel and he concluded his contribution to the proceedings by reading a long petition, signed by many airline pilots, that mileage pay should be retained and the hourly basis abandoned.

—Fiorello H. LaGuardia for the pilots.

—and Lester D Seymour for the operators

So much for the labor clauses At that point the pilots became spectators and conflict appeared between two groups of operators, on the section of the code which provides against starting any new competitive lines W. A. Letson, president of U. S. Airways, was opposed to the no-competition clause because it did not affect labor and was therefore out of place in an NRA code [Though as a matter of fact most of the codes that have been approved have many more provisions on fair and unfair trade practices than were contained in the air transport document]. Also, he felt that this check on new competition would create a property right in airways, which would be contrary to established Department of Commerce policy.

Amelia Earhart, of Boston-Maine Airways, placed herself upon the platform that "there are those who do not think air-mail subsidy is the basis of air transportation." The code article under argument would, she believed, penalize the newcomer, who might be more efficient than the oldtimer.

The most extended statement on this subject came from T. E Braniff, president of the Scheduled Air Transport Operators' Association, which represents a group of operators not holding mail contracts The purpose of the NRA, said Mr Braniff, is to increase employment and not to reduce it The non-contract operators employ a total of some 250 men Post-office appropriations had been used, he declared, not to develop the aviation business but to create monopolies, and he gave a somewhat detailed review of the enactment of the Watres Act and of his objections to it The present code would, he believed, perpetuate the favorite position of the holders of mail contracts. Every railroad had an opportunity to carry mail, and he favored a similarly open-handed policy toward the airlines

As AVIATION goes to press the code has not yet reappeared in its finally approved form It ought to do so within the next two or three weeks, but in the meantime there are rumors of the progress of the negotiations The gossip runs that the section covering pilots will go out entirely (so avoiding a dispute which had the appearance of shadow-boxing in any case, as the contending parties were, on most points talking about wholly different things and never getting anywhere near each other) and that the rule against new competition will either be cut out or modified to make it less sweeping,—perhaps by providing merely, as in the motor bus code, that the would-be organizer of a new service over an existing route must get a certificate of necessity and convenience from the Code Authority In the light of NRA policy as so far developed, these guesses are probably as good as any.

Continuing our studies of the air forces of the world, Commander Scaroni begins a series of three articles with an account of the history and current status of Italian bombardment aviation on land and sea. An officer in the Italian Air Service for many years, and a long time resident in Washington as Air Attaché at the Italian Embassy, Commander Scaroni is singularly fitted to interpret to American readers the problems faced by Italy's flying fleets.

The equipment of air forces

ITALY (PART I) BOMBARDMENT

By Comdr. Silvio Scaroni

IN OCTOBER, 1911, during the Italian-Turkish war, Italian military planes undertook several bombing missions in Libya—the first time in history that airplanes were so used. The machines were all of foreign design but they were piloted by Italian officers Italy had, as a matter of fact, airplane designs of her own under consideration, but none ready for active service at that time.

Not long afterward an Italian machine built by Mr. Bossi [later to achieve much prominence in this country and president of the American Aeronautical Corporation—Ed.] and fitted with an Italian-built S.P.A. engine won a prize of 25,000 lira for a flight from Rio de Janeiro to San Paulo, Brazil, and in January, 1914, Mr Penseuti, in a Caproni monoplane of 80 hp., set an Italian altitude record at 12 630 ft. Gabardini of Novara had already produced a small training monoplane which could be adapted for short distance reconnaissance and observation purposes, and at the beginning of 1915 the firm of Macchi, now famous for its high-speed designs (one of which now holds the world's speed record—AVIATION, June, 1933), entered the field with a parasol monoplane powered with an 80 hp. engine. Although this ship showed reasonably good performance it proved to be dangerously unstable and the design was abandoned. By May, 1915, however, when Italy entered the World War, a number of Italian built planes were available, but the designs had all been imported from other countries Caproni had long been at work, however, and by the early part of 1915 produced a three-engined biplane (Fiat A-10, 100 hp.) which was one of the largest ships to appear up to that time General Douhet [now famous for his sponsorship of the doctrine of independent air force action, especially in the extensive use of bombing types—Ed.] in July, 1915, proposed to build a fleet of 500 machines of this type but his suggestion was practically laughed out of court by the military authorities as being impractical and visionary Some 200 of these machines were actually built, however, during 1915 and 1916 and their excellent performance, comparatively speaking, is a matter of record Although certain experimental machines were built with one central power plant driving three propellers, one direct connected and the outboard propellers driven by chains, the CA 1 mentioned above, with its three engines and direct connected propellers, became the prototype of all Caproni multi-engined machines

The CA 1 machines soon became obsolete from a military point of view, first because they were deficient in power and, second, because the materials of construction were not entirely adaptable for use in the field The basic design proved perfectly sound and it remained only to make minor changes in construction and to find a satisfactory

Land Type Bombers

Name	Year	Engine	Horsepower	Weight (lb.)	Useful Load (lb.)	Maximum speed at sea-level (m.p.h.)	Service ceiling (ft.)	Range (hours)
Caproni—CA 1	1915	3 Fiat A 10	300	4 620	2,200	68.4	—	[illegible]
Caproni—CA 3	1916	3 I.F V 4 B	430	5 060	2 640	80.8	13 450	4·00
Caproni—CA.4	1917	3 Fiat A 12 bis	900	7 700	6 600	77.7		6 30
Caproni—CA 3	1917	3 Fiat A 12 bis	900	7 260	4 400	93 2	13 120	
S I A—Sia	1917	1 Fiat A 14	600	—	1 990	130.5	16 400	3 30
F I A T—B R	1918	1 Fiat A 14	683	3 226	2 200	133.5	19 690	3 00
F.I.A.T—B R 1	1923	1 Fiat A.14	695	5 310	2 860	145 5	21 980	4 00
Caproni—CA 66	1924	4 Spa 200	600	8 140	4 400	111 8	18 048	4 00
Caproni—CA 73	1925	2 Lorraine	620	7 040	3 960	108 7		4 00
Caproni—CA.101	1929	3 Lynx 200	600	5 500	3 300	112 5	16 400	—
Caproni—CA.74G	1930	2 I F Asso-500	1 000	8 800	4 840	111 8	18 200	6 00
F I A T—B R 3	1930	1 Fiat A 25	1 000	6 270	5 740	159 8	20 540	8 00
Caproni—CA 102	1930	2 Jupiter	1 000	5 900	5 740	156 7	19 660	[illegible]
Caproni—CA 79	1930	4 I F Asso-500	2 000	14 300	9 900	136 7	18 040	[illegible]
Caproni—C A 90.	1930	6 I F Asso-1 000	6,000	33 000	33 000	130.3	14 760	7 00
Caproni—CA 95	1930	3 I F Asso-1 000	5 000	26 400	16 520	111 8	11 480	8 50
Caproni—CA 111	1931	1 I F 750	750	6 600	4 400	152 2	19 660	10·65
F I A T—B R G	1932	1 Fiat A 24 R 2 Fiat A 24N	2 100	13 200	12 100	136 7		10 00
Breda—C.C 20	1932	3 I.F Asso-500	1 500	19 270	15 700	108 7	18 040	10·00

Seaplane Bombers

Name	Year	Engine	Horsepower	Weight (lb.)	Useful Load (lb.)	Maximum speed at sea-level (m.p.h.)	Service ceiling (ft.)	Range (hours)
Bastianelli e C/—P E R	1918	4 Fiat A 12 bis	1 200	13 696	4 400	104.4	6 090	—
S.I.A.I.—S 16 ter	1925	1 Lorraine	410	2 974	1 760	124 3	12 790	3 00
San Macchi—M 24	1924	2 Fiat A 12 bis	600	6,534	3 300	108 7	11 480	2.40
Cantieri Navali di Trieste—Cant. 6	1925	3 Lorraine	1 200	9 900	5 500	119 3	—	—
S I A I—S.55/A	1930	2 I F Asso/R	1 100	11 110	4 400	135 5	11 480	—

power plant. The latter appeared about the middle of 1915 in the Isotta Fraschini V.4B water-cooled engine of 150 hp. which made a new bomber design feasible, the Caproni CA.3. By the end of 1916 practically all of the active bombing squadrons were equipped with this type.

These machines were biplanes having double fuselages, each carrying a tractor engine in the nose, and a central nacelle with a pusher engine. The defensive armament consisted of two machine guns mounted in separate turrets, one in the nose and the other just behind the wings above the pusher engine. Normally the machine carried a crew of four, two pilots, one observer and a machine gunner. The CA 3 Caproni proved so successful that the design was taken over by France, England and the United States, and a number of machines were built in each of these countries.

Improvements in design were made throughout 1916, one of the most important being the provision for detaching the wing tips for storage without making it necessary to disturb the basic parts of the structure and power plants. A little later new Fiat engines made it possible to step the power up from 450 to 600, and then to 900 hp. The latter plane, with 900 hp. was designated as the CA 5 and remained the backbone of the Italian night bombing squadrons until 1926. During the latter part of the War some 600 machines of this type were built. One of the outstanding aerial offensives against the Austrian forces involved a raid with some 130 Caproni bombers in one group. A number of other notable bombing raids were carried out by Caproni machines.

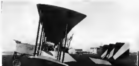
Notwithstanding the intense activity at the Caproni works with the construction of a large number of the Models CA 3 and CA 5, experimental work was concluded in 1917 for a new machine which departed considerably from the conventional. The CA 4 was a triplane of dimensions hitherto unattempted by any Allied designer. Although 38 of these machines were built, however, they became obsolete almost before leaving the hangars, for their immense size made them difficult to handle in the field and an easy target in the air, both for anti-aircraft guns and for pursuit ships. They were underpowered also in spite of the total of 900 hp. yielded by three Fiat engines.

By 1918 the improvement in enemy anti-aircraft guns and the remarkable advances made by pursuit aviation rendered the large Capronis less and less useful from the military point of view. Also the theater of operations of the Italian forces was in a country of high mountains and rate of climb and ceiling were important considerations. A shift in general tactics brought the day bomber into being. For this purpose machines were required which were very fast and maneuverable and which could defend themselves, as the protection of bombing planes by pursuit craft was not considered sufficiently safe. For this purpose the SIA-7B machine was developed, a biplane for one pilot and one observer fitted with water-cooled engine and equipped with a fixed machine gun firing forward and a movable machine gun aft for the observer.

Although the SIA's active service life was relatively short (it was replaced very shortly by the Fiat BR series), it was produced and used in large quantities, some 600 machines having been delivered.

An improvement over this type was made in 1918 by Mr. Rosatelli, chief engineer of the Fiat Company, who undertook the study and construction of a day bomber as a substitute for the SIA. This machine, known as the Fiat BR type, was fitted with a twelve-cylinder water-cooled engine of 685 hp. This machine is notable as it is among the first in which composite construction was used. All the highly stressed parts of the wings and fuselage were made of steel; the wings were fabric covered and the fuselage was plywood covered. The ship showed a speed of about 25 m.p.h. greater than any other of similar type then in existence. It carried a useful load of a little over 2,200 lb. and a service ceiling of about 220,000 ft. Preparations were being made to produce this type in large quantities at the end of the War.

During the early post-War years the question of light versus heavy bombing airplanes was a subject of great controversy in Italian military circles. One group favored the total abolition of the day bomber on the ground that improvement in pursuit tactics and equipment, and more effective anti-aircraft services rendered it obsolete for military purposes. The opposition argued that the comparatively high speed of the type made surprise attacks possible, and improved armament and the adoption of mass formation tactics offered adequate defence against attack by pursuit ships. The argument still persists, although there are indications that opposition to the day bomber is on the wane, its speed and high ceiling now being relied upon



Caproni biplanes have held the center of Italy's bombardment stage since the early days of the War

Top left: The CA 3 of 1916, widely used by Allied air forces. Top right: CA 60 first of the single fuselage series made its debut in 1924. Above: The more modern CA 74G (1930) still in active service. Note typical wing arrangement. Left: The gargantuan CA 90, one of the largest land planes ever constructed—an experimental type

The monoplane puts in an appearance for bombing types

Above: Caproni's twin-engined monoplane CA 102, 1930. Right: F I A T-B R G monoplane of 1932. Below: The influence of modern transport design is obvious in the Breda CC 20 of 1932

Pictorial history of the day bomber

Top: The prototype—the SIA-7B of 1917. Above left: The F I A T—B R, the direct ancestor of present Italian day bombers (1918). Above right: The modern day bomber F I A T—BR 3

to offset the earlier disadvantages Of course, extreme speed and high ceilings also characterize modern pursuit aviation, so the final answer to the question of the defensive powers of day bomber squadrons may have to be reserved until the next war

In spite of arguments, Fiat made considerable improvement in the BR series, producing two new models, the BR 1 and the BR 2 The latter designs differ from the prototype in that they have achieved a higher load-carrying capacity due to larger wing area, the N type interplane strut was substituted for the old single strut and wire combination, and the under-carriage modified to permit the mounting of torpedoes. The net result was a slight drop in top speed, an increase in carrying capacity and range Caproni at the same time had not been idle, and retaining his principles of design, a three-engined biplane with a biplane tail, improved his machine considerably In 1924 he produced the CA 66, a four-engined machine with a total of 800 hp and four SPA engines The original Caproni idea of two separate fuselages was abandoned, however, for the conventional single fuselage, and a radical departure was made in wing arrangement in that the top wing was very much shorter in span than the bottom, a characteristic which has been retained in the huge Caproni biplanes

Almost simultaneously with the CA 66 appeared the CA.73 a twin-engined night bomber, which although derived from the CA 66 design, differed enough from it to make it appear an entirely new plane A number of these ships were purchased to outfit bombing squadrons in place of the old CA 5 which was still in service at that time. A further modification in 1928 consisted in fitting two Isotta-Fraschini engines of 500 hp each under the designation of CA 74 Some of the latter type were purchased to replace the older CA 73 models Two years later further modifications were made in the CA 74G These changes were not basic, but included many items for the benefit of the observer and pilot such as an independent rudder control mounted in the observer's cockpit to allow him to give the final touch to the direction of the machine while aiming at the target on the ground below.

Coming down to current models, Italy seems for the moment satisfied with bombing planes built around 1,000 hp A number of experiments with bigger planes have been made but they are all private ventures which so far have not found much favor in official circles Since 1930 planes have been built in this category which run as high as 6,000 hp, but it may be said definitely that current Italian policy is directed toward the development of medium class bombers, and there is no indication at the moment that this trend will be abandoned for the distinctly heavy types This does not square with a recent statement in AVIATION that "there has been a great swing in Europe, especially in France and Italy toward emphasis on machines capable of carrying bombs heavy enough to wreck modern buildings when they are dropped in city streets"

I am glad to be able to assure my good friend the editor of AVIATION that as far as Italy is concerned, modern buildings have never been taken into consideration as a criterion for bombs, or the carrying capacity of bombers I would draw attention to the fact that at Geneva, Italy was almost the only nation to insist on very light bombing planes when its proposal for the entire abolition of bombing aviation was rejected.

In the bombing field the last of Caproni's productions are the models CA 101, 102 and 111 The first is a three-engined monoplane of 750 hp., of which some 60 have been put in service since 1929. Second, the CA 102, built in 1930, is a twin-engined monoplane of 1 000 hp of which some 70 have been ordered Further shifts in design policy were in evidence at this point for the three engined idea has been abandoned. So far there has been little evidence of standardization in design trends except towards metal construction Fuselage framing, wing and tail spars, landing gear, etc, are all made up of steel tubing Most of the ships have been fabric covered

Going back for a moment to the field of the day bomber, the BR 3, direct descendant of the 1918 Fiat BR series, appears to be the accepted service type Designed in 1930, the BR 3 is powered with a Fiat A 25 engine of 1,000 hp water-cooled It differs from its predecessors in its greater engine power, in more comfort for pilot and observer and in the modernization of all components Landing gear incorporates oleo-pneumatic shock absorbers instead of the older rubber mounted type, and the wheels are fitted with independently operated brakes Tail skids have disappeared in favor of tail wheels Fixed machine guns are rigged forward and observers are provided with a pair of movable guns Torpedo launching from this ship has been abandoned and bomb racks in which the bombs are hung horizontally instead of vertically have been substituted The useful load has been boosted from 3,300 to 3,740 lb

Seagoing Bombers

Below, right: SIAI-S10 designed in 1923
Below: The "Cantieri di Trieste"—1925
Right: The ocean-conquering Savoia Marchetti S-55

Some recent experiments

Between 1930 and 1932 a number of experimental heavy bombing machines were built by various Italian constructors Caproni built three of them, two biplanes, one of 2,000 and one of 6,000 hp, respectively, and one monoplane of 3 000 hp—the CA 79, CA 90 and CA 95. The CA 90 is notable in that it is one of the largest land planes ever constructed It is fitted with six Isotta-Fraschini engines of 1,000 hp each, placed in three sets of two in tandem The plane has made several important flights and has four World records to its credit

About this same time two other notable ships appeared, first the Breda CC 20 and the BR G. The CC.20 was designed by General Crocco and General Costanzi of the Air Force, and is a low wing cantilever monoplane of all metal construction, with a closed cabin for pilots and observer Side by side seats are rigged for dual control Three 500 hp engines are fitted The BR G is also a monoplane of the closed cabin type It is fitted with two Fiat A 24 engines and one Fiat A 24R, giving a total horsepower of 2,100 The structure is of mixed duralumin and steel. It is characterized by unusually large lift struts which function partly as outboard engine supports

Seaplane bombers

Italy with its hundreds of miles of seacoast and numerous inland lakes offers almost innumerable locations for seaplane bases Although during the War the country's only attempt to produce seaplane bombers lay in an abortive effort by Piaggio in 1918 to put a Caproni CA 5 (900 hp) on floats, much of the prestige of Italy's air services today rest upon the exploits of her seaplane bomber squadrons under the outstanding leadership of Italo Balbo

Shortly after the close of the War several unsuccessful attempts were made to continue seaplane bombing experiments A 1,200 hp flying boat was built in 1921 by Pegna and Bastianelli, but it was too slow and too heavy and shortly disappeared from the picture. An observation machine, really in the light bombardment category, was produced in 1923 by the firm S I A I, but the military authorities were looking for something heavier and no squadrons were equipped with this type Macchi, in 1924, made a gesture in the direction of bigger and better flying boats with a 600 hp flying boat which could take a useful load of 3 300 lb, but even this attempt was considered unsuccessful The following year, the "Cantieri di Trieste" with three Lorrain engines of 400 hp each appeared but although the machine carried a useful load of 5,500 lb, its other qualities did not recommend it and it was therefore dropped

The long looked for machine was achieved in 1924 with the appearance of the S.55, designed by Marchetti, of the S.I.A.I Since the visit of the Italian Squadron to New York in the summer of 1933 has made the appearance of this boat so well known, little description is required here. Suffice it to say that the flotation gear consists of two boat hulls, instead of one, fixed to a single wing of thick section, a cantilever without struts or bracing wires Two engines mounted in tandem are supported in a nacelle over the center section After some hesitancy the design was accepted in principle by the Air Ministry and later in quantity by the squadrons Its use by General De Pinedo, Major Del Prete and General Balbo on outstanding long distance flights has made the machine well known not only in Italy but all over the world Although the basic design remains today much as it was in 1925, the last few years have shown considerable improvement in detail and a considerable increase in engine power The latest model the S.66 having three separately mounted pusher power plants in place of the tractor-pusher two engine arrangement of the S 55, was exhibited at the 1932 Paris Salon

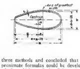
Summing up the production situation in Italy today with respect to bombing airplanes, the S.I.A.I firm holds a virtual monopoly on the seaplane bomber with the S 55 type, just as Caproni enjoys the same privilege in the night bombing field and Fiat in the realm of the day bombing plane with the BR.3 [Italy apparently has never insisted on the maintenance of two or more parallel sources of supply for her aircraft as is the policy in the United States—Ed.]

Streamline tubing sections

Some useful formulas

If streamline tubing sections could be defined in terms of simple geometrical shapes, the section properties (area, least moment of inertia, least radius of gyration and location of centroid) could be readily calculated, but unfortunately commercial streamline sections do not lend themselves readily to such treatment. There remain, then, three possible methods of determining the actual properties of commercial tubing for use in design first, laboratory tests on samples second, mechanical or longhand integration from carefully made drawings, and third the development and use of approximate formulas

Under the direction of R. L. Templin, chief engineer of tests of the Aluminum Company of America, E. C. Hartman of the Aluminum Research Laboratories has made a careful investigation of all three methods and concluded that approximate formulas could be developed which could be applied satisfactorily for all practical purposes Referring to the accompanying figure, Mr Hartman's findings may be summed up in the following relationships



$$A = \frac{KW}{wL} \qquad (1)$$

$$I = \frac{\pi}{64}(b^3a - d^3c) \text{ (nominal dimensions)} \qquad (2)$$

$$R = \sqrt{\frac{I}{A}} \qquad (3)$$

$$e = \frac{f}{10} \qquad (4)$$

where

A = cross section area—sq in

W = wt of sample—lb

L = length of sample—in

w = wt of material—lb per cu in *

$K = \frac{(ab - cd)\text{ (nominal)}}{(ab - cd)\text{ (measured on sample)}}$

I = least moment of inertia—in^4

R = least radius of gyration—in.

e = distance from midpoint of major axis to centroid

$a, b, c, d,$ etc = (see figure)

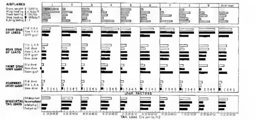
*For 17-s alloy, 0 101 lb per cu in

Balloons

Participants in the International James Gordon Bennett Trophy Race

Above: One of the baskets in which a balloon crew makes its home for the duration of the race. Left: Hydrogen and illuminating gas were mixed to provide the necessary inflation medium. Below: The winner. The Polish entry piloted by Capt. Franciszek Hynek and Lieut. Zbigniew Burzynski.

Less than two hours before launching time the balloon of Fritz von Opel tore in half. The upper part made a spectacular sole of 250 ft.



EFFECT OF THE NEW DEPARTMENT OF COMMERCE REGULATIONS ON A GROUP OF EXISTING MODERN AIRPLANES
Nine ships recalculated under the new rules and the changes charted for comparative purposes. Tail loads appear to be lower but new distribution rules actually make them more severe.

Rationalizing stress analysis

A new system for the Department of Commerce

By Richard M. Mock

ON SEPT 14, the Aeronautics Branch of the Department of Commerce held its annual conference with the aircraft manufacturers to discuss the proposed changes in the Airworthiness Requirements for Aircraft (Aeronautics Bulletin 7-A). Present requirements have been based largely upon experience with the result that they are largely empirical rather than based upon the theoretical considerations of the performance of the airplane concerned. At a similar meeting two years ago the manufacturers requested a more rational method of stress analysis to be based upon assumptions conforming more closely to actual conditions. After a thorough study the Department proposed an entirely new set of regulations which admittedly do not reach their ultimate goal—complete rationalization but do provide a system on a rational basis that can incorporate further refinements as new aerodynamic and structural data are obtained. Furthermore rationalization of the basic assumptions makes it possible to deal with unconventional types of airplanes with more ease and consistency than is now possible. By having more accurate knowledge of the performance limitations of the airplane, its aerodynamic and structural characteristics, a more refined structure can be built having a lighter empty weight and allowing a greater useful load.

It was originally planned to adopt the new regulations on Jan. 1, 1934, but although the manufacturers had already agreed on the fundamental principles of the proposed requirements, it was felt advisable to postpone adoption to about July 1, 1934, so that the problem could be more thoroughly studied and more experience and data, especially on high speed airplanes could be obtained. In the meantime, the present Bulletin 7-A will continue in force and any design submitted for approval that has a contemplated speed over 150 m.p.h. will be considered as a special case.

The greatest differences between the present and proposed Bulletin 7-A are in the wing and control surface requirements. The fuselage and landing gear requirements have been revised to only a minor extent.

A number of proven successful airplanes, originally built in accordance with the present empirical method were recalculated and it was found that in order to conform with the proposed regulations their structural weight would have to be appreciably increased reducing the payloads accordingly. It was felt therefore that the proposed requirements should be investigated further. It was brought out, however, that most new high speed transports were designed in accordance with or to exceed the proposed requirements. Because of lack of sufficient knowledge it is likely that some of these planes are considerably overstrength in parts thus reducing their available payload. Eugene L. Vidal, Director of Aeronautics, pointed out in this connection that one additional seat per plane is worth altogether about $2,000,000 a year to operators.

Speaking for the aircraft manufacturers Clayton Bruckner, president of the Waco Aircraft Company of Troy, Ohio, presented a list of basic points which had been prepared beforehand by the Engineering Committee of the Manufacturers' Section of the Aeronautical Chamber of Commerce. This group had classified and studied about 150 letters from various engineers and manufacturers making suggestions on the proposed regulations. It had boiled down the results to four main points on the subject of rationalization and in addition, had submitted a list of some 20 other suggestions of minor nature not pertaining to rationalization.

The first point in the discussion on rationalization was that of basic external loads and the possibility of establishing more than one category. R. G. Minshall of Boeing suggested classifying airplanes as either acrobatic or non-acrobatic [following current British practice], and that loads be divided into those due to gusts and rough air and those due to the actions of the pilot. He proposed that the entire airplane (not just the wings) be calculated for gusts and that the airplane only be calculated for the type of maneuvering it will be subjected to in service. Passen-

ger transport planes need not be calculated for barrel rolls, loops, and other acrobatic maneuvers Mr Bruckner proposed a reduction in load factor for planes not to be stunted in which he was supported by J M Gwinn of Consolidated. The latter mentioned his firm's two-place training plane designed for certain acrobatic loads when carrying a definite gross weight, but which he believed should be allowed to carry a greater weight for cross-country and non-acrobatic flights Richard C Gazley, Chief of the Engineering Section of the Aeronautics Branch agreed with this reasoning but doubted if the reduction in load factor would be very much and felt that it would be an added complication

The second point concerned the further study of high angle of attack load factors Mr Gwinn expressed the opinion that modern large airplanes with servo controls can be maneuvered quite as rapidly as small planes If in such ships it is left to the pilot's judgment to avoid creating unnecessary loads, why not rely upon his judgment in all airplanes. Each plane could be conspicuously placarded as to its limiting safe diving speed. Mr Gazley expressed the undesirability of revising load factors downward He brought out that it was the inertia factor which they considered in assuming that large airplanes were less maneuverable than small.

In discussing the third point, the effect of rationalization on weight, Mr Perkins of Curtiss-Wright acting temporarily as chairman of the Engineering Committee, remarked that eight comparatively slow airplanes already in service some time, have been recalculated in accordance with the proposed requirements and in general the results showed little effect on the structural weight. Reductions in one part balanced increases in other parts He pointed out one case of a satisfactory modern transport that would have had its payload reduced 7 per cent if it had been designed in accordance with the proposed requirements

Mr Gazley then presented the accompanying chart comparing the external loads on nine airplanes calculated by both the present and proposed requirements These planes varying from a 38 000-lb flying boat to an 850-lb land plane represent the cases that are the most severe under the proposed regulations The values shown are for total loads and do not include the effects of distribution Though the horizontal tail loads appear to be lower the distribution in the proposed regulations make them more severe A E Larsen of Pitcairn, using the Pitcairn Mailwing as an example, said that although this plane had been proven airworthy by years of flying in all kinds of weather it would have to be increased in empty weight by 3-4 per cent in order to conform to the proposed requirements Considering other designs it had been calculated that some parts of some proven airplanes would be very much heavier One plane studied would have the weight of its tail increased 300 per cent, though it had already been proven satisfactory in service. He suggested that the design criterion for the tail be both rigidity and deflection and not the load alone A. F. Arcier of Waco said that in one of their designs, proven by actual service to be airworthy, the proposed requirements would increase the empty weight f½ per cent Mr Perkins mentioned that these increases in structural weights were on comparatively slow airplanes and that the loss in useful load might be even greater in high-speed designs. Mr Gazley pointed out that there must be some sacrifices going from an irrational to a rational system Col V E Clark of General Aviation then stressed the need of economy in air transportation, pointing out that if the present requirements are wrong and are strong enough we should hesitate to write a law increasing the structural weight still further Mr Gazley agreed and expressed the feeling that the six months postponement of the adaptation of the proposed requirements should allow sufficient time to investigate the matter more thoroughly

The fourth and last point raised involved the possible simplification of the present requirements. Mr Gwinn discussed in detail the possibility of reducing the number of conditions to be calculated and drew some sketches to illustrate his suggestions. He suggested that only three conditions of flight need be calculated instead of the proposed seven besides the condition of unsymmetrical loading

The new requirements now proposed include the following design conditions for the wings and wing bracing (1) *high angle of attack, pull up*, (2) *high angle of attack, up gust* (flying at 90 per cent of indicated high speed and encountering an upward gust of 30 ft. per sec), (3) *steady dive condition* where limited diving speed $= 9\ V_l + K_d\ (V_m - 9\ V_l)$ in which V_l is maximum speed in level flight, V_m is the maximum theoretical vertical velocity with zero propeller thrust, and $K_d = 0.08 + 1.85/(.001W + 3)$; (4) *low angle of attack, pull up* (limited diving speed and 65 per cent of load factor for Condition (1) but not less than 2.0); (5) *low angle of attack, up gust* (same as 2 but gust of 15 ft per sec), (6) *low angle of attack, down gust* (similar to 5), and (7) inverted flight (applied load factor is 40 per cent of that in Condition (1) with a minimum of 1.5). In each condition the *applied load factor* is determined and multiplied by a *factor of safety* of 1.5 This value of 1.5 is lower than that nominally required by some governments but is believed by the Department to be satisfactory when used with conservative load factors

In Condition (1)—*high angle of attack, pull up*,—the applied load factor is based on the following equations

$$n = 1.0 + \Delta n \left(\frac{15}{p}\right)^{.435}$$

$$\text{where } \Delta n = 0.77 + \frac{32}{w + 9.2}$$

n = applied load factor for Condition (1)
w = gross weight (W) divided by 1,000
p = power loading based lb. per hp. (total rated hp)

When plotted (Air Commerce Bulletin, Aug 15, 1933, Fig. 10, page 53) the curve of the new load factors conforms generally to the present one except that in the new requirements a smoother curve results This causes airplanes under 2,500 lb to be subjected to higher load factors than heretofore, as are planes from about 4,000 lb to 8,000, depending on power loading Planes from about 12,000 lb to 20,000 have the same or slightly lower load factors, while above 27,000 lb they are definitely lower. The basic assumption is that a severe pull-up will be made at slower speeds as the size increases.

Under the proposed requirements, although the total horizontal tail loads are in most cases lower than before, the distribution is such that tail structures become heavier It should be kept in mind, however, that under the present conditions tail surfaces are usually considerably overstrength as they must be static tested to their full design load In the proposed regulations the tail must be calculated for the dive loads determined from the wing analysis with the applied load increased 25 per cent and distributed over the leading edge of the stabilizer. Another loading condition is that for deflected elevators The load is concentrated on the rear half of the stabilizer and on the elevators. The minimum factor of safety is 1.5 for externally braced surfaces and 1.75 for cantilever surfaces The distribution of loads on the vertical tail surfaces is similar.

Another fuselage loading condition has been added, side load on tail landing gear

In make-up the proposed requirements differ from the present Bulletin 7-A in that they are divided into two parts—Proposed Bulletin 7-A "Airworthiness Requirements for Aircraft" and Proposed Bulletin 26 "Design Information for Aircraft." The former is limited to the requirements, while the latter outlines recommended procedure and practice in the analysis and design of airplane structures It is understood that most of Bulletin 26 must be followed Though in parts it is based upon present Bulletin 7-A the details are generally quite different especially in the determination of the loads on the airplane

High-output engines

A British point of view, and an American one

LIKE all good technical societies in all enlightened countries, the Society of Automotive Engineers promotes international exchange of experience. The society's meeting in Chicago last month had a particularly cosmopolitan color, and both England and Germany made contributions to the aeronautical sessions. Eagerly awaited, as presenting the collected opinions of one of the world's greatest experts on aero-engine design and one of the most brilliant of practical designers, was a paper by A H Roy Fedden chief engineer of the Bristol Airplane Company, manufacturer of the famous Jupiter, Pegasus (which holds the present altitude record) and Mercury

Almost with his opening words he confessed to comparative conservatism, and little faith in such persistent dreams of indomitable inventors as gasoline turbines and barrel engines, at least in the immediate future He was inclined to expect that operation on the familiar four-stroke cycle would continue the general rule, being doubtful of the feasibility of running a two-stroke engine at high speed and with satisfactory efficiency, except possibly with direct fuel injection or with diesel operation Though liquid cooling might sometimes seem to be gaining ground, he was entirely confident of the future of the air-cooled types, and he felt that the pendulum in Europe was now swinging in their favor

The speaker's anticipation ran to higher engine output for a given volume, and he expected improvement in performance to be secured largely from increased speed Gearing is already the virtually universal practice in British engines, so stepping engine speed up to far beyond the possible limits of propeller speed will occasion no radical change in engine design, but merely a further change in gear ratio In America the tendency has been rather to hold the speed down and to increase output by raising the compression ratio and the intake blower speed, and so the brake mean effective pressure To some extent, of course, increased speed and increased pressure can be combined. At the present time the conventional rating of British (and most American) aircraft engines is from .33 to 40 hp per cu in of piston displacement, an increase of about 50 per cent in the last twelve years Mr. Fedden thought the present figure could be doubled again within the ten-or-fifteen year period that he was considering, which would be equivalent to taking 1,000 hp from a Wasp or 1,400 hp from a Cyclone Such powers as these have not yet been attained even in racing, at least with air-cooled engines Roughly 0.6 hp per cu in seems to have been about the limit in racing service based on modified commercial engines, though of course the liquid-cooled engines created exclusively for Schneider Trophy service have done considerably better than that Air-cooled motorcycle engines have given up to 1 hp per cu in, when tuned for racing, or about a third higher than Mr Fedden anticipates for aero engines in the near future, and the ears that race at the Indianapolis Speedway deliver engine powers up to 1.8 hp per cu in Such figures are reached only by running at 6,000 r.p.m or higher, and only with cylinders having an individual piston displacement of 20 cu in or less, as against the 100 to 200 cu in per cylinder that is common in aircraft engine practice Mr Fedden thought it unlikely that there would be any very startling reduction in weight per horsepower in the near future At least he did not believe that the weight could be reduced nearly as much as the cylinder volume and the diameter and frontal area of the engine.

Improved performance is closely bound up with improvement in fuel, and to fuel the speaker turned his attention before analyzing individual features of engine design He paid America the high compliment of recognizing this country as the pioneer in the standard use of high-quality fuel, but European countries are now catching up and even getting ahead Mr Fedden considered further study and further progress on those lines of paramount importance both for civil and military purposes, and he was in favor of standardizing on the use of lead tetra-ethyl in quantities not exceeding four cubic centimeters per gallon

Outlook for supercharging

Increases in output such as the speaker foresaw could only be attained with a generous use of supercharging, and he expected to see some kind of supercharging arrangement on every aircraft engine in the future. Mr Fedden was convinced, however, that satisfactory supercharging demanded that the engine have a well-designed induction system and the most generous valve and port areas

He considered the usual single-stage constant-speed centrifugal blower, as installed on all large American radial engines, unsatisfactory for supercharging to any considerable altitude because of the necessity for throttling near the ground and of the serious power losses in the blower under that condition The Roots blower had certain advantages, especially in flexibility of control, but he felt that it did not adapt itself well to radial engines A more promising prospect seemed to lie in the two-speed centrifugal blower running at moderate speed near the ground and stepped up through a shift in gears to a higher speed at the altitude where full supercharging was necessary. Remarkable figures were given for the performance of such a blower on a Bristol Pegasus engine, where the two-speed blower reduced the take-off run by 30 per cent and increased the rate of climb at sea-level by 10 per cent, as compared with the performance with a single-speed blower having slightly less ultimate supercharging effect The two-speed blower increased the weight only 35 lb If supercharging for altitudes of more than 15,000 ft. or thereabouts was to be demanded, Mr Fedden expected to see a swing back to the exhaust-driven turbo-compressor

Cooling and engine temperature

The speaker was quite disturbed about cowling problems, particularly about the effect of low-drag cowling on engine cooling Undoubtedly the problem is more serious in England than in America at present because of the

almost universal use of reduction gearing and large low-speed propellers, but whatever the cause might be, Mr. Fedden found it absolutely essential to increase the fin area on the cylinders of his engines to a considerable degree when ring cowling began to be used. He remarked that baffles between the cylinders were rather generally used in America since ring cowling had become common, but British experience was definitely hostile to baffles.

As far as a full NACA cowl was concerned although that type yields a lower total drag than the ordinary short ring, Mr. Fedden had found it definitely impossible to use one with a geared engine and to keep the cylinder and oil temperatures within the limits established in Great Britain. Remarking on the widespread use of the NACA cowling in America, he nevertheless "could not believe that this type of cowling could allow a reasonable working condition for the engine except in the case of passenger or racing aircraft." [There have, of course, been numbers of successful applications of the NACA type on American military planes, notably on recent bombers.]

Common practice in the past had been to allow about 6 sq in of cooling surface for every cubic inch of piston displacement but at present, quite aside from any cowling problem, Mr. Fedden and other designers have stepped that up to about 12 sq.in. per cu.in. He believed that within the next few years there would be an increase to somewhere around 20 sq in. [All of these figures are on the basis of from 25 to 30 sq in of cooling surface per horsepower, or about one-fifth the amount of cooling surface that is commonly used in a radiator for a water-cooled engine and a little less than a half what is needed in the radiator for a Prestone cooling system.] Mr. Fedden found it "quite conceivable that the ultimate solution of the cooling problem will lie in the permanent inclosure of the air-cooled engine in a suitable duct and cooling it by an engine-driven fan"—as in a Franklin car. He also thought there might be possibilities in the combination of air-cooled barrels with permanently sealed jackets on the head to contain Prestone, the jackets being finned on the outside and the heat distribution being kept uniform by the circulation of the liquid as in salt-cooled valves. [This scheme was developed two or three years ago by John H. Geisse now chief of the Department of Commerce inspection service and was extensively tested in the laboratory.]

Cylinder fins

The Bristol Company has recently conducted a very extensive series of tests on cylinder cooling under the unfavorable conditions of an extremely low air speed and has developed an entirely new cylinder design as a result. Mr. Fedden draws the conclusion that close pitch of the fins is of great importance, and that in spite of certain limitations which the machined cylinder head lays upon the designer the machined head is superior to the cast one. The machined fins of the present Bristol cylinder are set considerably closer than even the closest of the American cast fins.

Considering valve design and valve gears for high-speed engines Mr. Fedden would still uphold the cause of double valves (four valves per cylinder in all) as offering an increased gas-passage area. In two-valve cylinders he found the gas speeds likely to be much too high and he preferred to avoid that difficulty even at the cost of elaboration of the valve gear and some increase of weight. He believed that it would be absolutely necessary to use dual valves if cylinders as large as 183 cu in. (which is about 10 per cent smaller than the cylinders of the Cyclone and the Hornet) were to be run at speeds as high as 2 200 r.p.m. If there was to be only a single exhaust and a single inlet valve he did not think it practicable to use cylinders of more than 90 cu in. displacement (slightly smaller than cylinders of the Wasp Junior or the Whirlwind) at such engine speeds as he considered likely to become common practice in future—3 500 to 4 000 r.p.m.

Sleeve valve vs. poppet

Mr. Fedden's belief in the probable survival of the present general type of aircraft engines does not extend to its valve mechanism which he considered as quite inadequate for the high speeds that he expects to encounter. A hydraulic tappet is a possibility, but he looked rather to the acceptance of an overhead camshaft for each cylinder and cams operating directly on the valve. Another possibility would be to abandon the poppet valve entirely in favor of the sleeve valve. The Bristol Company had studied that possibility extensively and had even built a nine-cylinder radial with sleeve valve and put it through the British Air Ministry's acceptance test for 100 hours without the slightest trouble and with a lower fuel and oil consumption than had ever been achieved on any poppet-valve engine of otherwise similar characteristics. In the meantime the poppet valve continues in use and salt-cooled valves, heretofore almost an American monopoly on service engines, are about to be introduced into regular use by two leading British firms. Mr. Fedden, however, is searching for a substitute, whether it be a sleeve valve or something else.

Cylinder arrangement

With passing remarks upon the necessity of improved materials and of introducing controllable pitch or automatically variable pitch propellers, Mr. Fedden returned to a closing survey of the merits of various general types and cylinder groupings. While he thought little of diesel engines in small sizes he believed that they might have an important place in civil aviation and in long-range flying boats, in sizes somewhere around 1,000 hp. About direct fuel injection he was less optimistic. So far as general arrangement was concerned the debate for the future was likely to lie between the single-row and the double-row radial engines. Mr. Fedden still supported the cause of the single-row engines for most purposes.

When it finally became necessary to abandon the single row because of demands for very high power Mr. Fedden believed that the ideal solution would not be found in the present type of staggered radial but in the "double-bank in-line engine as first seen in the design of the Curtiss Chieftain some years ago." That works out particularly nicely with sleeve valves and overhead camshafts. With that arrangement it should be possible to develop up to 1 000 hp. [Such rapid progress has been made on the single-row radial in the past four years that the 1,000-hp. mark would seem likely to come within reach of nine cylinders if we could depend upon only a very little extension of the term of maximum power as it has been drawn since 1930.] For still higher powers Mr. Fedden leans toward the two-stroke diesel.

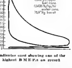
Experimental Bristol sleeve valve cylinder. An engine of this type has made a very creditable showing in Air Ministry 100 hour tests

Mr. Fedden concluded by drawing an interesting parallel between present British and American tendencies as shown in two leading representatives of their respective national practices, the Bristol Pegasus and the Wright Cyclone, which happened to be shown side by side at the Paris Salon last December.

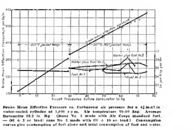
High output cylinders

The British report on high output in the future has been general and far-reaching in its terms. The American contribution was much more specific. It dealt with the development of high-output cylinders with poppet valves and was written and presented by Ford L. Prescott of Wright Field, already the winner of the Manly medal for the best paper on an aeronautical engine subject presented to the Society of Automotive Engineers during 1932.

The prevailing rule in air-cooled engines under service conditions is to run up to a maximum brake mean effective pressure of 160 lb. per sq.in. Mr. Prescott took that as a jumping off place and rose to a height of 230 lb. per sq.in. with a straight air-cooled engine and actually over 575 lb. per sq.in. with liquid cooling. [The racing automobile engine already referred to has a B.M.E.P. of about 220 lb. per sq.in.] The method of raising the pressure was to supercharge. The problem was to do the amount of ground supercharging necessary without running into detonation. The solution was to modify the engine design in detail and especially to modify the fuel. Supercharging was carried up to 70 in. of mercury above atmospheric, an increase of pressure on the carburetor of 35 lb. per sq.in., considerably higher than has ever been realized in racing cars. (It should be noted that the supercharging was done independently of the engine and the engine was not charged with the power required to run the supercharger. To that extent any direct comparison of the B.M.E.P. secured in these tests with those obtained on regular service engines would be misleading.)



Indicator card showing one of the highest B.M.E.P.s on record



Brake Mean Effective Pressure vs. Carburetor air pressure for a 4⅞ in.x7 in water-cooled cylinder at 1,600 r.p.m. Air temperature 70-80 deg. Average Barometer 30.2 in. Hg. (Runs No. 1 made with Air Corps standard fuel — 08 + 2 cc lead; runs No. 2 made with C0 + 10 cc. lead.) Consumption curves give consumption of fuel alone and total consumption of fuel and water.

Cams and compounding

To stand these very high pressures a very heavy piston with five rings was used. The oil pressure had to be raised to 100 lb. per sq.in. to care for the needs of the big-end bearing. Compression ratios used were 5:1 or a little higher, and piston displacement around 120 cu in. per cylinder (midway between the Whirlwind and the Wasp). Special cams were developed for the purpose of the test with a hollow face on the intake cam and tangential cheeks on the exhaust cam. Fuel was a California gasoline with from 7 to 10 cc. of lead tetra-ethyl per gallon giving an octane number of 95 or better. At the very highest B.M.E.P. water injection is used. This is an uneconomical device when the water must be carried as a part of the load of the airplane for the total consumption of water and fuel runs about 0.7 lb. per hp.-hr. Total consumption of water and fuel together tends to increase somewhat with increase of the supercharging but the increase is all in the water that has to be added to prevent detonation. Consumption of fuel alone shows some decline with rising pressures. Mr. Prescott suggested the possibility of getting much increased economies by compounding, discharging the exhaust into a low-pressure cylinder where it can be further expanded to do more useful work. For the B.M.E.P. of 575 lb. per sq.in., the peak pressure during explosion rises to over 1,500 lb. per sq.in., and the pressure still stands at some 350 lb. per sq.in. when the exhaust valve is open and about 250 lb. per sq.in. when the piston reaches the end of its downstroke.

Valve dynamics

The major contribution to the discussion of Mr. Prescott's paper came from Otto Burkhardt, formerly research director of the SAE. Mr. Burkhardt, like Mr. Fedden, severely criticized the insufficient rigidity of the operating mechanism used on poppet valves. Elasticity in the valve gear sometimes accounts for a lag of 12 deg. in valve openings, and, on account of vibrational resonance with valve springs sometimes becomes responsible for valve chatter and spring breakage. Mr. Burkhardt recommended that cam contours be redesigned as a regular practice in all high-speed high-efficiency engines so that the acceleration of the valve would grow gradually to a maximum instead of passing at once from zero to its maximum value and thence dropping abruptly to a maximum negative value with the lift half completed. Mr. Prescott agreed that Mr. Burkhardt's points were important and that acceleration of the valve should be applied gradually. In defense of the poppet valve, however, he pointed out that the mechanism used for driving valve sleeves might also have a lag due to elastic distortion under the force required to accelerate the sleeve.

Carlton Kemper, of the National Advisory Committee for Aeronautics, called attention to the virtues of direct fuel injection (about which both the NACA and certain American engine manufacturers are much more optimistic than Mr. Fedden is inclined to be) especially in cases where a large valve overlap was employed and where much fuel would be wasted if it came in with the intake air. With a boost pressure of only 6 in. of mercury the NACA laboratories had developed a B.M.E.P. of 200 lb. per sq.in. at 1,750 r.p.m. That exceptionally high value (none of Mr. Prescott's curves showed more than 160 lb. B.M.E.P. with so little boost) was due to the excess scavenging of the exhaust that was possible with direct fuel injection and a large valve overlap.

E D I T O R I A L S

AVIATION

EDWARD P WARNER, *Editor*

Over The Spanish Main,— Over The Mid-Pacific

THE NAVY did it! We always knew they could, and that is why we have dinned away in these pages upon the argument for some really impressive long distance overseas flying in squadron formation. When six naval flying boats made the trip from Hampton Roads to Coco Solo in the Canal Zone without a stop, covering a longer distance than any that the Balbo squadron had to span between stopping places, they proved that our confidence was justified.

Now let's see the Navy follow up on their own performance!

From Hampton Roads to Coco Solo is 2,059 miles. From San Francisco Bay to Pearl Harbor on the Island of Oahu is 2,372. The boats that made the expedition out of Hampton Roads to the south with such apparent ease are on the point of being able to follow the trade winds from the Golden Gate westward to a resting place in the Hawaiian group. The boats that make that flight, in turn, can equally well keep on to the west and south by easy stages until they arrive in Australia for a courtesy call, then northward to the Philippines, and, should the political situation make it desirable and should the Japanese Government wish to receive them, to Kobe or Kasumigaura.

Our own air forces have been copiously urged to "return General Balbo's visit." It would be a graceful act, but it would show a dismal lack of originality. Let us strike out on a new course. The air routes of the Pacific have been explored only by individual pioneers. Let's demonstrate that they can be covered by aircraft in groups with that same impressive consistency which marked General Balbo's crossing of the North Atlantic. Let's refresh old friendships and make new ones by a gesture which we believe would be no less appreciated than was the Italian Air Force's visit to New York and Chicago. And let us by all means remind ourselves and the people of our Hawaiian territories that the islands of the Mid-Pacific are now closer to the United States than ever before, and that aerial communication with Honolulu need no longer be classed as a sporadic stunt. The Navy Department has itself furnished the proof that the material and personnel for doing the job exist. It remains only to take the decision and to prepare the organization of the flight.

Competition for carburetors

IT IS just a little more than three years since the first public demonstration of a gasoline aircraft engine with electric ignition and with direct injection of the fuel into the cylinder was given at Hartford. Over that length of time the study of the problems of direct injection has gone steadily and quietly forward in several factories and in widely separated government laboratories—to say nothing of the work done in various European countries. Direct-injection engines are in regular service upon one of our airlines, and they are undergoing the most serious examination by the Air Corps and by the Navy. They make it possible to use hydrogenated "safety" fuels which the ordinary carburetor system will not handle, and they seem to eliminate the problems of freezing which have been so vexing in some cases. Though the direct-injection engine at best is very far from displacing its carbureted rival, still it seems to us that it deserves more attention than it has yet had, and that results of laboratory trial have not always been given the prompt opportunity to verify themselves in service that they have deserved.

Anyone who was in faithful attendance at the aeronautic sessions of the S.A.E. at Chicago last month will recognize the source of our sudden interest. Any listener during the presentation of Mr. Prescott's paper (reported elsewhere in this issue of AVIATION) must have been struck by the tremendous possibilities of raising mean effective pressures and engine outputs which his experiments suggest. The particular methods used by Mr. Prescott, with supercharging to some 40 lb. per sq.in. above atmospheric pressure, are inapplicable in regular service under present conditions, but the National Advisory Committee for Aeronautics has found devices for gaining at least a part of the ground of these super-output cylinders and for increasing the brake mean effective pressure to approximately 100 lb. above present levels. Supercharging need not be pushed beyond limits now conventional. All that is

required is the use of direct injection with a valve overlap so great that the pure air taken in through the intake before the injection of the fuel begins will scavenge the exhaust gas with a perfection far beyond anything attainable with conventional four-stroke carbureted engines. To provide a valve overlap of over 100 deg. on the conventional type of engine would be nothing less than a form of incendiarism, and it would save time if the fire alarm were to be turned in before starting the engine. Even without the fire danger, however, so much of the incoming mixture would be poured out through the exhaust valve that the consumption figures on such an engine would put even the lavishness of a racing motor-cycle to shame. But when the intake valve admits only fresh air, and when the fuel is supplied separately and at a later date, neither fire hazard nor fuel waste need haunt the designer. He can, as the N.A.C.A. has amply demonstrated, use an overlap of but little less than half a revolution of the crank shaft. He can, as the N.A.C.A. has further proven, increase his brake mean effective pressure thereby to no less than 240 lb. per sq.in., with no more than the customary amount of ground boost, and actually with a reduced fuel consumption.

The National Advisory Committee has been the subject from time to time of rather severe criticism because it has insisted on sticking to its proper job of research and has refused to assume the function of the industry and go the length of building complete planes or engines based upon the work of its laboratories. The organization at Langley Field is a research organization. If the industry is to get the benefit of the studies made by it, the industry will have to take the results and apply them in service equipment. It may be that recent work upon direct injection of fuel and the starting effect of valve timing on its value is already in course of application by the industry, but we are frankly disturbed at the apparent lack of interest in this particular investigation, both at the meeting in Chicago and elsewhere. Unless American engine manufacturers and the American services are giving more attention to the subject than has so far become evident, they are not giving nearly enough.

What kind of training?

GONE FOREVER are the halcyon days when some thousands of young men labored under the blissful delusion that attendance at a flying school and the acquisition of a private, or at most a limited commercial, license would be the pass-words to fame and fortune. Too many of the victims of their own enthusiasm have gone back to driving taxicabs or keeping books, and their successors are approaching the study of aviation in a different spirit. They are being wiser beforehand, in order that they may not be sadder afterwards.

It has come to be recognized that piloting is a profession, and that it requires not only some hundreds of hours of wholly preliminary experience by way of training, but a long period of apprenticeship in the co-pilot's seat on top of that before the equivalent of a master merchant mariner's papers can be claimed. What is not so often understood is that the management of the operations departments of air lines is recruited largely from among present or former pilots, and that even the greatest proficiency at the controls and the greatest degree of weather wisdom is hardly a sufficient list of qualifications for an executive.

Piloting can be approached from two points of view, It can be considered as an end in itself, a profession of which its members may be justly proud and to which they may devote their entire careers, or it may be approached in the hope that it will lead ultimately to the opportunity of entering a managerial or an executive role. A transport pilot who is to be that alone still needs a knowledge of mechanics, of radio and electrical equipment generally, of meteorology both in the forms of weather-map interpretation and of reading of the signs in the sky, and of navigation by half-a-dozen different processes, which would have been wholly alien to the pilot of a few years ago. The pilot who looks forward to the possibility of leaving the cockpit for a swivel chair behind a desk needs all that and much more besides, particularly a knowledge of economics and of the factors that have controlled and are likely to control transport development.

For the man who expects to make his livelihood from aviation, the "flying school" is obsolete. It has no place in his plans. Anyone who supposes that he can leave high school and learn to fly and be qualified for useful employment is building disillusion for himself. He needs the equivalent of at least a considerable amount of specialized collegiate training in addition to his flying. The type of training that he needs has almost nothing in common with the type that is needed by the young man who intends to buy a plane of his own or who simply wants to learn to fly for the sake of knowing how. The two groups of students must be taken care of on differing lines and in separate schools, and the schools of aeronautics must divide themselves sharply into two categories. One is concerned with flight training almost exclusively. The other counts that a minor part of its activities, and should have something like the atmosphere of a college. The division of the two groups has already been accomplished to a large extent, but it is not yet complete. Every school operator who has failed up to the present time to assign himself to one class or the other ought to do so without further delay.. Persisting in his failure, and trying to scrape in more revenue by belonging to both classes at once, he will end by satisfying neither.

NEWS OF THE MONTH

Racing for records

MAJ JAMES DOOLITTLE'S speed record for land planes fell when James R Wedell of Louisiana streaked across the Chicago skies in his Wedell-Williams 44 monoplane at an average of 305.33 m.p.h topping Major Doolittle's record of a year ago by more than 10 m.p.h The plane, which was powered with an 800 hp. supercharged Wasp engine was equipped with a controllable pitch propeller (Hamilton Standard), a feature now becoming common in major racing planes.

With little difficulty, Wedell flying the same ship took first place and $5,600 in the Phillips Trophy Race. Lee Gehlbach in another Wedell-Williams plane came in second, and Roy Minor in Ben Howard's Menasco-engined monoplane followed in third place It was in this race that Miss Florence Klingensmith lost her life while piloting her Gee-Bee at 220 m.p.h Colonel Roscoe Turner, consistently losing revolutions due to supercharger trouble, abandoned the race after the eighth circuit.

By way of interlude, H E "Spud" Manning, with a sack of flour for company, bailed out at 14,000 ft. to make one of his famed delayed parachute jumps The flour left a snowy trail across the blue sky until at 1,000 ft., he jerked the rip cord and came down to a perfect landing in midfield About a week later, Manning, and two companions were drowned when their autogiro disappeared in Lake Michigan.

While the heavier-than-aircraft were chalking up records in Chicago, Lieut Com T G Settle brought his balloon down in Branford Connecticut, after having covered a 750-mile flight from Chicago in the James Gordon Bennett Cup race a distance some 120 miles short of that which won him the Gordon Bennett Trophy last year After walking for a week to civilization, the Polish aeronauts, Captain Hynek and Lieutenant Burzynik reported that their flight of 812 miles had ended in the Canadian forests Ward T Van Orman and Frank Trotter drifted about 500 miles in the Goodyear IX and were finally forced down in a storm They, too, traveled through the Canadian wilds and were rescued because they had the foresight to cut down a telephone pole. The repair man who came to investigate the trouble finally discovered them The Polish entrants covered the longest distance, Lieutenant Commander Settle was next with 750 miles and Van Orman and Trotter were third with a total of 500 miles

A new west to east trans continental air record was set when Col Roscoe Turner flew from Burbank Cal to New York, 2,520 miles, in 10 hours, 5 minutes This time beats the old record of 10 hours 19 minutes made by Jas. H Haizlip on Aug 29, 1932 Colonel Turner flew a Wedell-Williams monoplane which averaged 275 m.p.h., although at times making 315 m.p.h. stopping to refuel at Albuquerque, N M, Wichita Kan and Indianapolis, Ind It was his plan to seek a round-trip record by starting back for Burbank, but abandoned this on receiving bad weather reports Colonel Turner also holds the east to west record of 11 hours 30 minutes.

At the S.A.E. banquet during the Chicago races the Guggenheim medal was awarded to Commander Jerome C Hunsaker, head of the Mechanical Engineering Department at M.I.T., for achievements in aeronautics including his contributions to the design of lighter-than-air craft and meteorological studies leading to dirigible use in transatlantic service

Record-breaking public

The American Public stepped into the country's transport planes to pile up 21 417,110 passenger-miles this past July, an indication that the country is more air-minded than last year by some 6.642.000 passenger-miles With many business enterprises still long-faced and woebegone, Eastern Air Transport, Inc, reports an increase of 95 per cent in passengers carried in the first eight months of 1933 over the same period in 1932 American Airways claims a 36.6 per cent increase in the passengers served in August 1933 over the 10 537 carried in August 1932 United Air Lines established an all time record for air travel between Los Angeles and San Francisco by carrying a total of 2 015 passengers between the two cities in August The airplanes have bowed graciously to our First Lady whose frequent trips have proved such an excellent example The Century of Progress has stimulated travel without doubt, however, this taking to the air in wholesale numbers is another evidence of the great American passion for speed

Airlines oblige

Eager to please, the airlines are meeting the enthusiasm of the public for air travel with improved service Eastern Air Transport has announced a new night air passenger service to become effective Sept 15 Atlantic seaboard benefits Out west, Transcontinental and Western Air has speeded up its service so that New York to Los Angeles travelers get there 50 minutes sooner United Air Lines are now shuttling five times a day between Los Angeles and San Francisco and are considering adding a sixth daily schedule American Airways is facilitating New York-Chicago traffic by the addition of two new schedules

Stepping well into the lead of European airlines, Pan-American Airways System announces that during the first six months of this year, it carried 39 446 passengers The 44-passenger "Clipper Ships" operating daily between Miami and Havana carried a substantial amount of this traffic As a result of the improvement in export trade conditions, the air mail volume has grown so that the United States Treasury has realized a profit over and above the expense of the service which the Post Office Department bears

No missing links

Before very long the Atlantic Ocean is going to be encircled with a commercial air route The Graf Zeppelin which has made over 40 trans oceanic crossings will be employed in a year-around Zeppelin Service between Germany and South America Luftchiffbau has negotiated a loan of 3 000 000 marks from the Brazilian government, part of which will be used to construct a hangar at Rio de Janiero to Dr Hugo Eckener's specifications

Strengthening the southern link will be a weekly South Atlantic Air Mail service between France and South America to be inaugurated by Aeropostale in April, 1934 Pan-American Air Lines form the connection between North and South America and has sent Colonel Lindbergh to study conditions in the Northern Atlantic area with a view to establishing an air route in that direction

Coco solo ferry flight

In the late afternoon of Sept. 7, there departed from the Naval Air Station at Norfolk, Virginia, six twin-motored monoplane flying boats under the command of Lieut Comdr D M Carpenter of VP Squadron 5F When they landed at the Fleet Air Base at Coco Solo, Canal Zone, they had completed the longest non-stop formation flight ever made a distance of 2,059 statute miles The flying boats are service-type long range planes (P2Y1) built by the Consolidated Aircraft Corporation At Coco Solo, they will take their regular assigned positions in the service squadrons based there This flight exceeded by 195 miles the longest leg of any flight made by the Italian Flight Squadron commanded by Gen Italo Balbo There is a rumor to the effect that the VP Squadron 5F will return the visit of Balbo and his men

Down under

Heading once again for Little America, a southland which is neither sunny or warm, Rear Admiral Richard E. Byrd is anticipating discoveries which may establish the feasibility of an air route from Australia to Africa In addition to the old revenue cutter Bear which is to be used for the purpose of breaking through the ice, Admiral Byrd is taking a second vessel the Jacob Ruppert The two ships will carry all the expedition's supplies (some 14 000 different items) Everything to provide sustenance and research equipment for two years will be stowed in the two vessels Admiral Byrd, willing to go down for adventure alone, expects, however, to find data which will aid in solving many of the problems of some ten branches of science

The penguins are due for a surprise, for stowed away on one of the ships is a Kellett K-3 autogiro, a cabin type ship for two passengers, with which the Admiral hopes to land vertically in locations too difficult for ordinary planes to negotiate A Curtiss Condor, powered with two Wright Cyclone engines will be part of the air force The Condor, equipped with skis for making snow landings (floats are also being taken—see page 333), has a cruising speed of 155 m.p.h., and a fuel capacity of 1,100 gal., enough for 1,800 mile cruising To save weight, all upholstery has been omitted Buried in the snow down in Little America is a Ford airplane for the nose of which a new Wright Cyclone 700-hp engine has been taken The two Whirlwinds on the wings are expected to be salvaged and put in flying condition With all this paraphernalia, the adventurers anticipate a great amount of flying and hope to discover whether or not the land claimed for the United States on the last expedition is a continent.

Of the 70 men of the personnel, about twenty were on the first expedition. Harold I. June will go as chief of aviation, and Commander Noville, who was a member of the North Pole expedition, will act as advisory engineer Paul Siple, the boy scout who was on the first trip, is going again. Another famed member of the first expedition, Bernt Balchen, is already well en route, but with the Lincoln Ellsworth Antarctic Flight Expedition Thirty-eight members of the Admiral's party will winter on the ice in 1934

Captain Mollison returns

Determined to break the long distance flight record of Codos and Rossi, Captain Mollison came back to America with his new De Havilland Dragon, the Seafarer II. Before the plane is assembled adverse weather may have set in, so that it is impossible to say when the Mollisons will make their attempt, although a late September starting has been rumored. While the Captain was superintending the crossing of the Seafarer II, Mrs Mollison was traveling around the United States on an inspection tour of our airlines As a result, she said that commercial flying in America is at least two years ahead of that in Europe.

Saving with safety

After receiving the preliminary reports covering studies of operating costs for the Aeronautics Branch of the Department of Commerce, Secretary Daniel C Roper decided that wisdom impelled the restoration of all airway lights on the transcontinental and Seattle-Los Angeles west coast routes to full time operation In his statement concerning the operating budget of the Aeronautics Branch for the coming year, Secretary Roper said

"Full time operation of the lights on connecting lines will require an additional expenditure of $120,000 for the balance of this year

"It is my well-considered opinion that this is important in the interest of the preservation of safety of life, and consequently, I shall ask the Director of the Budget for this additional amount . . .

"The lights are operated automatically by astronomic time clocks, the mechanisms of which must be readjusted because of the present part time schedule Mechanicians are starting work

Secretary Roper continued with a few remarks concerning the operating policies of the Branch

"There has been no change in the policy or personnel in the Medical Section except through voluntary resignations.

"While there have been a large number of employees dropped from the payrolls of the various divisions in order to effect economies, the replacements have been limited to the appointment of six men to positions that directly involve carrying out the policies of this Administration Each of these men has had extensive aeronautical experience Such experience will be the criterion in any future appointments

"During the fiscal year 1933, the Aeronautics Branch operated at a cost of $7,339,000 On the basis of present estimates we will operate on approximately $2,000,000 less than that amount"

Calendar

Oct. 7-8	National Air Pageant Roosevelt Field Long Island N Y
Oct. 12-13-14	Meeting National Association of State Aviation Officials Cincinnati Ohio.
Oct 20-21	Annual Convention National Aeronautic Association Washington D C
December	International Rally Cairo Egypt
Dec 14	Meeting of the Federation Aeronautique Internationale Cairo Egypt
February	Viceroy's Challenge Trophy 700 mile Race Delhi India
Feb 9-13	Races — Dedicating Shushan Airport New Orleans La
May 27	Deutsch de la Meurthe Cup Race

Public works in the air

Determined to speed up its program, the Public Works Administration is sending four of its staff on a 6,000 mile airplane tour of the country to discuss problems with the regional authorities Their function will also be to study various proposed projects and report on them to Washington so that opportunities will be provided to put men to work immediately

Mr. Cord again

In accordance with its policy of expansion, the Cord Corporation bought the Smith Engineering Company, thus obtaining control of the Smith Controllable Pitch Propeller, which was used by Wiley Post and Major Doolittle on his Gee-Bee Hereafter, the propeller will be manufactured by the Lycoming division of the Cord Corporation in Williamsport, Pa.

Unhappy landings

The Washington-Hoover Airport in our nation's capital has come in for its full share of criticism Pilots deplore the mud on rainy days and, rain or shine, they don't like the abbreviated runways Government officials consider the Military Road which bisects the field a white elephant—in fact, they will give it away, if Congress will let them. Probably a better idea would be to abolish it altogether inasmuch as its presence prevents the construction of proper runways Few airports have more potential traffic than the Washington Airport, and few major airports in the United States are operating with such limited facilities

National air pageant

Some 75,000 persons are expected to fill the largest portable grandstand in the world during the National Air Pageant out at Roosevelt Field next Oct 7 and 8 Lieut. Comdr. Frank M Hawks is going to lead the Liberty treasure hunt over a course from St Louis to New York, Maj Alexander P de Seversky intends to establish the first category of amphibion records in his new plane (AVIATION, July, 1933) Other participants promised Air Commodore P F M Fellowes leader of

the Houston-Mount Everest Expedition; Capt. Edward V. Rickenbacker, World War Ace, Maj James H. Doolittle and Col. Clarence D. Chamberlin. A night flight air derby will be staged over the Transcontinental & Western Air route from Los Angeles to New York with a trophy and $3,000 cash prizes the rewards to winners

A year in the air

Seventeen transport pilots reported to the Department of Commerce that each had over 10,000 hours flight time to his credit—almost fourteen months E. Hamilton Lee of Omaha, pioneer air mail pilot, has accumulated a total flying time of more than 15,000 hours The total accumulated flying time on active transport licenses is 11,510,000 hours

"Deutschlandflug"

With spirits and good humor unquenched by a deluge of rain on Aug 24, 125 pilots waited calmly for the next day and an improvement in weather to commence the Deutschlandflug in which mere youngsters were competing with well-known and experienced aviators. After a classification and speed test at the Berlin-Staaken airport, they all returned to the Templehof for the take-off The low-wing monoplane type of machine dominated the scene, and of the 125 entrys, 83 were Klemms. Three trips, one for each day, were arranged throughout Germany. Each evening the ships returned to the Templehof After a rather complicated method of scoring, it was decided that the first prize was to be divided between pilots Kohnk and Hoift, both flying Klemms.

U. S. Rundflug

Bearing fellowships covering an intimate study of things aeronautical in America, two young German engineers, Paul-Eduard Köster and Walter Schilo, are just starting on an extensive tour of the country in their own plane, an American built ship purchased upon their arrival Expecting to follow the airlines for the greater part of the trip, very complete radio equipment has been installed. Their itinerary includes practically every point of interest where aeronautical products are built or sold. Both are pilots of long experience. Each has served as pilot for the American Air Attache at Berlin.

Dutch "Caravan"

Commercial, military and private flying in Holland joined in a tour of the country on Aug 25 and 26. This is the second year that the air enthusiasts of Holland have clubbed together to form the popular "caravan" In 1934 they hope to make it an international event. Taking off early in the morning from the Waalhaven aerodrome at Rotterdam, the 32 machines flew over the Northern Provinces to Enschede where they spent the night. The second day they returned to Waalhaven by way of Flushing The land of the wooden shoes is an air-minded country

Service abroad

The Sphinx, whose slightly startled expression has been wearing off lately, will probably take the advent of the new Egyptian Air Service more or less stoically Misr Airwork has scheduled a service between Cairo and Alexandria using two British biplanes each equipped with two 130-hp engines and seats for eight to ten passengers Flights will be made in each direction twice a day, and the rate will be a little higher than train fare. Late in 1933, the Indian National Airways are planning to inaugurate a service from Karachi to Rawalpindi There are two possible routes, and although a 1,500 mile survey has been made the final course has not been definitely settled. Five-passenger multi-engined planes will be used. In the British Isles, the Midland-Scottish Air Ferries Ltd. are reported to be planning a transportation service to accommodate Cork, Dublin, Belfast, Glasgow and Manchester This route will be opened in September

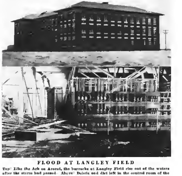
The Italian Airways have established a new run from Trieste to Brindisi with stops at Zara and the island of Lagosta both on the eastern shore of the Adriatic At Brindisi, it is possible for travelers to take either planes or steamers across to Greece and Egypt.

Parachute ladies

One day in the Aeronautics Branch of the Department of Commerce, somebody discovered that ten women in the United States had been licensed to repack and repair parachutes A candidate for such a license must demonstrate a sufficient knowledge of inspecting, maintaining, repairing and packing a parachute and must have packed 20 or more which were either satisfactorily jumped or drop tested. Since there are only 312 licensed parachute riggers, and the Air Commerce Regulations require that every parachute carried on flights in aircraft be repacked every 60 days, the feminine riggers should have no need to be idle

Over the ether waves

The world should not want for news from Antarctica this season, with some of our best radio equipment now trekking in that direction Lincoln Ellsworth reports from Auckland, N Z, that with the equipment to be used on the



FLOOD AT LANGLEY FIELD

Top: Like the Ark on Ararat, the barracks at Langley Field rise out of the waters after the storm had passed. Above: Debris and dirt left in the control room of the full scale wind tunnel after the rushing waters had swept through Although the damage was estimated at $300,000 all equipment was in condition to operate within three weeks

ANTARCTIC CONDOR

Rear Admiral Richard E Byrd takes delivery of Curtiss-Wright Condor No 41 powered by two Wright Cyclones and equipped with three-bladed Smith controllable pitch propellers Standing before the Condor from left to right are J. S. Allard, vice-president of the Curtiss-Wright Corporation; Admiral Byrd and Harold I. June, chief pilot for the Second Antarctic Expedition

Ellsworth Transantarctic Flight Expedition, having an output of 100 watts, he anticipates no difficulty in exchanging messages with New York while flying to the Weddell Sea The transmitter, so constructed that it can function on any wave length between twenty and eighty meters, will be mounted in the rear of the fuselage and operated by remote control The receiver may be run either from batteries or from the output of the engine generator An emergency transmitter and receiver of very light weight will be carried in addition to the above equipment so that communication with the base will not be cut off in case of accident.

Without stirring from the warmth of your fireside, you will be able to follow the vicissitudes of the Byrd Antarctic Expedition if the plans of Admiral Byrd and the Columbia Broadcasting Company materialize. From the polar regions, the original broadcast will travel 4,000 miles to Buenos Aires where it will be amplified and re-broadcast to New York The Columbia receiving apparatus will pick it up at this point and relay it to the nation The difficulties caused by insufficient meteorological data, limited available power and the distance which the sound must carry, class the broadcast as an experiment rather than a certainty. However, Inventor Marconi has expressed his confidence in the feasibility of the transmission

Air agreement

A reciprocal agreement between the United States and Sweden has been made to take effect on Oct 9 which provides for the operation of civil aircraft of one country in the other, the issuance by each country of pilots licenses to citizens of the other country and an acceptance of the airworthiness requirements of one country by the other In 1927 such an agreement was made with Canada, after which a similar one was signed by Italy An agreement on a partial basis exists between Germany and the United States

Russia, Ahoy!

Furthering their investigations of the proposed northern air route on behalf of Pan-American Airways System, Col and Mrs Lindbergh flew to Leningrad, U S S R., from Sweden to discuss plans with the Soviet air representative. Because the United States and Russia have not yet established diplomatic relations, the Lindberghs were not officially received, although their universal popularity won for them the cheers that are characteristic of every welcome accorded them

New aeronautics head

Secretary Roper of the Department of Commerce has appointed Eugene L. Vidal director of Aeronautics Although he will not hold the same rank as did Col Clarence M Young who resigned several weeks ago, Mr Vidal will direct all activities of the department. Mr. Vidal was at one time assistant general manager of the TWA airlines after which he established the Ludington Line He is a graduate of West Point and a resident of South Dakota

As his chief aids, Mr. Vidal will have Maj. J. Carroll Cone as director of air regulation and Rex Martin, who will be in charge of the air navigation division.

The reorganization of the Aeronautics Branch provides for two major divisions instead of three as heretofore The Air Navigation Division will cover in addition to its former duties radio research, airways mapping, and airport engineering consultation. The Air Regulation Division provides for three principal subdivisions, one dealing with airline inspection, another with general inspection work covering miscellaneous flying activities, and a third subdivision common to both and including registration, engineering, medical, accident and enforcement work

Airports increase

Since the first of August, 30 new airports have been established in this country representing municipal contribution to the advancement of aviation Ewing Y. Mitchell, Assistant Secretary of Commerce, pointed out that in opening new airports and improving the landing facilities of old ones, communities will find themselves benefited by new revenues brought in by increased flying which will inevitably follow closely be-

General de Pinedo

On Sept 2, Gen. Francesco de Pinedo attempted the long distance flight to Bagdad which ended in his death before he had cleared Floyd Bennett Airport. His overloaded Bellanca staggered down the runway only to crash into an iron fence where it caught fire The Marchese de Pinedo started his career in the Italian Navy and in 1917 transferred to the air service. Innately adventurous, he caused astonishment in aviation circles when eight years ago he made a 35,000 mile flight touching Australia, Japan and India Later, after commanding a flight of 35 seaplanes, the Marchese was appointed Italian Air Attache at Buenos Aires

Capt. E. E. Harmon

Fog and driving rain over Long Island brought death to Capt E E (Tiny) Harmon, well known Army pilot, as he was searching for Mitchell Field after flying from Washington Apparently mistaking the Connecticut for the Long Island shore, his ship crashed in a wood near Stamford Capt Harmon will be remembered as the pilot of the Martin bomber on the Army's famous Round-the-Rim flight of 1919

hind economic recovery. As an example of ideal facilities, Mr Mitchell mentioned the new Bendix Field at South Bend The airport is a little over two miles from the center of the city and has an area of 412 acres There are three runways over 3,000 ft long and two 2 500 ft long Preparing for expansion, the airport engineers have allowed space so that each of the runways can be extended to be a mile in length A passenger terminal and three hangars have been constructed and an excellent system of boundary lights which illuminates not only the outskirts of the field, but also each runway, has been installed.

Reinstated pilots

The N A A Contest Committee has voted to recommend to the Executive Committee that due to the fact that participants in the Air Races recently held at Chicago had expected the sanction of the N A A, the F A I pilots who were suspended be reinstated effective Oct. 1, 1933.

Dewoitine records

Marcel Doret while testing the new Dewoitine "D 332" transport was so successful as to break four world records 1,000 km with 2,000 kg load at 160 m p h (an increase of about 20 m p h), (2) 200 km with a 500-kg load at 158 m.p.h. (an increase of 17 m p h.), (3) 2,000 km with a load of 1,000-kg at 158 m p h (an increase of 17 m p h), (4) 2,000 km with a load of 2000-kg at 158 m p h (an increase of 94 m p h) The highest speed attained was 186 m.p.h. M. Pierre Cot took this new Dewoitine with its Hispano 9 V engine on his tour to Russia recently

Pan American program

Pan American Airways has drawn up a program of improvements for the next four years which calls for an expenditure of $5,000,000 About half of this will be spent on equipment in addition to the amount already involved in contracts with the Sikorsky Aviation Corporation and the Glenn L Martin Company for the "Clipper Ships." An international seaplane base is to be established at Miami, Florida, which will consume $1,000 000 of the total proposed expenditure No announcement has yet been made as to what manufacturers will benefit by the outlay on equipment

Glider record

Another world record has been officially broken Russell Holderman, at the D W Airport in Leroy N. Y, looped his glider 35 consecutive times. Mr Holderman was towed by an airplane to 6,500 ft where he started the looping having first been freed from the airplane

SIDE SLIPS

By Robert R. Osborn

WE SEE by the papers that somebody in Italy has broken the record for upside down flight by staying in that attitude for 3 hours, 6 minutes and 39 seconds, whereas the previous record was held by a Californian, 2 hours and 20 minutes.

In case there should be any question how to classify this record, we suggest that it be placed in the same file with

the record for consecutive outside loops, the record for flag-pole sitting, and the record for carrying an electric stove in an airplane for the first time in history.

Van Orman and Trotter certainly had some thrilling experiences as a result of landing their balloon in the wilds of Canada. However, we were entirely unimpressed by their statement that their fall to the ground broke off a pine tree ten inches in diameter We have been on skiing trips up into Ontario with Bill Crosswell, test pilot of the Curtiss Company, and we have seen him break

down pine trees nearly that large while on skis, just by colliding with them as a result of errors of navigation.

We certainly hope to be able to look into free-ballooning and gliding some day, as they must be wonderful sports to have any devotees at all—the proportion of actual thrill to walking back is less than in any other sport we have ever heard of

Our Hangar Flying Department

AT a recent dinner in his honor we heard Wiley Post give some answers to questions about his great solo flight around the world, which we consider well worth repeating They certainly do give one interesting side lights on the flight which can't be gained from the newspaper accounts

Question What sort of food did you take with you on this flight?

Answer: Oh, just whatever they gave me at the various places I stopped. I haven't been able to figure out what some of that Russian food was, even yet! At one Russian stop they put in a huge loaf of black bread—a big round thing which must have weighed 25 lb I couldn't even dent it but I took it along to keep from hurting their feelings—it may be in the ship yet

Question Tell us something about your automatic pilot.

Answer: A fine thing for lazy pilots like me! I just rode around the world.

Question: Do you like the American 3.2 beer better than vodka?

Answer: Oh—the vodka is 3 2 also, 3.2 per cent water, and the rest alcohol

Question How did you manage to stay awake for such long periods?

Answer: I ate so little I was too hungry to sleep

Question How could you ask directions in so many countries where you couldn't speak the language?

Answer: Fortunately the names of the large cities sound the same in all languages and I have the sign language worked out fairly well by now My greatest difficulty came when I got lost while flying to Novo-Sibirsk in Russia I finally came on a railroad which I knew must lead to that city but I had no idea whether I was past it or not Finally spotting a good field near the track with two farmers working in a nearby field, I decided to land and ask directions Walking over to the two men I said "Novo-Sibirsk" and pointed up and down the track Then one man pointed up the railroad and the other down, so I had to guess at it anyway

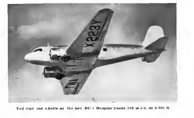
Question Are you planning to make another flight again soon, Mr. Post?

Answer: Well, after the fuss over this last flight died down a little I decided to pay a visit to my home town in Oklahoma. All the people there are friends of mine but there's one old character I like particularly well. He took me aside and said, "Wiley, I hear talk about you making another one of these flights around the world and I don't want you to try it again Your trips are entirely too hard on us folks here in Oklahoma"

FLYING EQUIPMENT

Douglas airliner for transcontinental service

EXCEPT for a few amphibions of the "Dolphin" class delivered for private use or for limited transport services, the output of the Douglas plant at Santa Monica, Cal, has to date been definitely militaristic To meet Transcontinental & Western Air's requirements for new equipment, however, Douglas has entered the commercial field on a large scale The delivery of the first of an order of twenty DC-1 transport airplanes marks the beginning of a new high-speed shuttle service between New York and Los Angeles over the TWA system



Tail high and wheels up the new DC-1 Douglas clocks 218 m p h. at 8 000 ft

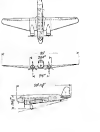
Safety, speed comfort and economy have been the keynotes of 1933 transport airplane design and an analysis of the specifications indicates that the new Douglas machine yields an exceptionally high rating on all four points Under the head of safety may be listed such features as all-metal construction, a comparatively great amount of shock-absorbing structure ahead of and below the passenger compartment, high performance with one engine cut (an altitude of 9 000 ft. has been reported on one engine with full load), low landing speed (60 miles per hour at sea level), and steep gliding angles through the use of trailing edge flaps the ability to land without damage (except to propellers) and with full braking facilities with wheels fully retracted, a wide range of vision from the pilot's cockpit (including a full view of the retracting undercarriage), quick-acting dump valve on fuel tanks, full fire-extinguishing equipment, and a full complement of the latest navigational and communication instruments.

High speed was forecast through exhaustive wind tunnel tests on interference and careful attention to aerodynamic cleanness Engine nacelle positions follow N A C A recommendations for low drag and high propulsive efficiency The ship shows a high speed of 188 m.p.h. at sea level, 210 m p h at 8,000 ft It cruises at 184 m ph at sea level and at 190 m p h at 8,000 ft, all figures being in excess of any so far reported for ships of its size and capacity With the landing speed indicated above, the speed range of this airplane is worthy of note

On the score of passenger comfort, nothing has been overlooked The cabin, 6 ft. 3 in high throughout and 5 ft, 6 in wide, normally accommodates 14 passengers in 7 rows of two each, spaced 40 in from seat back to seat back For short hauls where extreme roominess is not essential (and where gasoline capacity can be reduced) accommodations can be installed for 21 passengers. The seats are of special Douglas design, fully adjustable, and are mounted individually on rubber to minimize direct vibration Seat backs are reversible to permit passengers to sit face to face if desired Since the cabin floor passes over the top of the wing structure, there is no obstruction of any sort in the cabin Entrance is through a door on the left side of the fuselage in the rear Aft of the door is a complete buffet, and beyond a fully equipped lavatory

Stephen J Zand, acoustical engineer of the Sperry-Gyroscope Company, whose work with the new Curtiss-Wright Condor has been previously reported (AVIATION, July, 1933) handled the sound-proofing of the new Douglas By careful attention to rubber-insulating the engine mounts, by eliminating all direct contact between the structure and the cabin lining, by extraordinary care to eliminate all direct leaks (even to the extent of providing rubber gaskets for the cabin doors and designing special door locks without keyholes); and by a liberal use of Seapack (kapok processed into sheet form) and other sound-

Note how a modified fuselage shape gives full head room throughout cabin of the new Douglas Airliner



deadening materials in the 3 in space between outer and inner shell, the average sound intensity in the cabin at cruising speed was reduced below 70 decibels—an outstanding achievement.

In connection with the sound-proofing development a complete ventilating and steam heating system has been worked out. Controlled ventilation is effected by admitting air through a vent in the nose of the fuselage and distributing it throughout the ship by ducts A thermostatic control insures that the temperature in the cabin will remain constant at 70 deg with outside air temperatures going as low as —20 deg F

Economy results from good aerodynamic design (maximum performance from minimum power) and practical common-sense arrangement of component parts (for minimum maintenance and servicing expense) Exhaustive wind tunnel tests and careful calculations insured acceptability on the first count, and an extensive specification of features required for minimum maintenance based on TWA's long operating experience guaranteed the second

Getting down to structural details the entire machine is built of Aluminum Company of America's 24 ST and 24 SRT Alclad. The wing is of a cellular multi-web construction (similar to that used in the Northrop Gamma and Delta) and is tapered in plan and in thickness N A C A Airfoil Section No 2215 was used at the root, and No. 2209 at the tip. The central portion of the wing is built integral with the fuselage and serves as a mounting for the engine nacelles and the retractable landing gear Outer wing panels are demountable by means of bolted joints. Two main fuel tanks of 180 gal. each and two auxiliary tanks of 70 gal. each are mounted in the center section on each side of the fuselage.

The fuselage itself is a full monocoque with both the vertical fin and the horizontal stabilizer built integral. Longitudinal and directional trim are obtained by tabs in the rudder and elevators. The filleting of the wing and tail surface intersections has been carefully studied for minimum interference effect. All controls, including those for the trimming tabs, are internal

Landing wheels retract upward and forward into the engine nacelles by a simple hydraulic mechanism Counterbalancing the landing gear has made possible the use of hand operation only Retraction is accomplished in 25 seconds and lowering in 20 seconds by means of a pump within easy reach of either pilot or co-pilot. When in the retracted position the axles rest in sockets attached to the main nacelle bulkhead Hydraulic brakes with a differential control operating through the rudder pedals are provided. Shock absorbers are of the Douglas hydraulic type A 42x15.00-16 tire is used

The engine nacelles are monocoque except for the steel tube supporting structure forward of the firewall The entire mount, including engine and all accessories, is quickly detachable and interchangeable right and left Removal is facilitated by grouping all connections at the firewall and by using quickly detachable plugs for all electrical connections Carburetor air intake is of sufficient capacity to prevent icing Direct-cranking electric starters with shielded boosting coils are used. Hamilton Standard controllable pitch three-bladed propellers are standard equipment.

Every possible feature for the comfort, convenience and safety of the pilots has been included The control columns are located between the pilots and the outside walls so that there is no obstruction between the seats Full instrument equipment has been installed on rubber-mounted vibration-proof boards Under TWA specifications the latest type of Western Electric two-way radio has been installed including directional beacon receiver. All wiring for the radio or for other electric circuits is carried in aluminum conduit

The ship is designed to accommodate either two Wright Cyclone F-3 engines (geared 11:16), each developing 710 hp at 8,000 ft., or two Pratt & Whitney Hornet D geared engines with an output of 700 hp at 6,500 ft The general specifications as given by the manufacturer are Length over-all, 60 ft., span, 85 ft ; wing area, 946.6 sq ft ; fin area, 28.9 sq ft , rudder area, 42.5 sq ft, stabilizer area, 97.6 sq ft.; elevator area, 48.0 sq ft , aileron area (total), 86.8 sq ft , weight empty, 11,780 lb , useful load (including radio and all equipment), 5,720 lb , gross weight, 17,500 lb ; power loading, 12.3 lb per hp ; wing loading, 18.5 lb per sq ft.

Fokker F-20 for K.L.M Note unusual length of nacelles

Fokker FXX in active service

IN February, 1933, AVIATION published a description of certain new Fokker air transports which were then under construction for K.L.M The first of these machines has recently been extensively test-flown preparatory to going into service on the Amsterdam-Batavia run and, as a result, certain modifications have been made which have yielded appreciable increases in performance It will be recalled that the F-XX is a three-engine high-wing monoplane for 12-20 passengers (useful load is 7,700 lb) As has been usual in Fokker practice, the outboard engines were hung under the wings in separate nacelles. The landing gear was fully retracting into the nacelles In the original arrangement when the wheels were up the openings were completely covered with hinged panels.

It was found after some experiments that by making several relatively simple changes some weight saving and simplification of structure and maintenance resulted, The most noticeable feature was the lengthening of the nacelles, a modification which shows up clearly in the accompanying photograph. The basic structure remained unchanged, but the fairing of the after part has been very materially lengthened The hinged wheel hatch covers were also entirely removed. These changes resulted in an increase in top speed of 5 m p h

With a gross weight of approximately 19,500 lb and with a total of 1,920 hp developed by three Wright Cyclone Fs, a top speed of 186.5 m p h is reported The ship cruises at 155 m p h and is landed with the flaps down at 64 m p h The normal range is slightly over 1 000 miles

A New Kellett Giro—Model K-4

A CASUAL glance at the Model K-4 autogiro, just announced by Kellett of Philadelphia discloses a number of features that differ materially from older models The fixed wing area has been noticeably reduced As before, the wings are mounted in the conventional "low" position, but each panel is straight from root to tip (the upturned tip having been completely eliminated), and they have been rigged with very pronounced dihedral They taper both in

Kellett's Model K-4 Autogiro

thickness and in plan The ailerons were mounted in the usual manner. The change in wing type is reported to have increased the flying qualities of the machine, and to have increased the range of vision from the cockpit.

Improvement in undercarriage is marked. The multiplicity of struts and wires which characterized earlier models has been eliminated in favor of a smooth and sturdy tripod structure for each wheel supported from the wing Landing loads are transferred to the fuselage through a pair of diagonal struts on each side. The tread is unusually wide Low-pressure tires and wheel brakes are fitted. Parking brakes are also installed. Both the main wheels and the pneumatically tired tail wheel are fitted with oildraulic shock absorbers.

The usual four-bladed rotor is in evidence, but the supporting pylon has been reduced to two vertical members in the plane of symmetry, wire braced to the upper longerons The whole pylon structure has been inclosed in a streamline housing which presents a very clean appearance

Characteristically Kellett seating arrangement is for two—side by side Normally, the cockpit is open, but a demountable inclosure can be furnished The ship is powered with a Continental R-670 engine of 210 hp., direct connected to a Hamilton Standard propeller A Heywood type compressed air starter is standard equipment. Priming is from the cockpit. The oil capacity is 5 gal ; gasoline capacity, 45 gal. Mechanical fuel pump, with a hand operated emergency wobble pump, is provided. Fire extinguishing system is installed. The general specifications, as given by the manufacturer, are Length overall, 19 ft. 11 in , span, 24 ft. 7 in , height on the ground, 12 ft 3 in.; fixed wing area, 63 sq ft , rotor diameter, 40 ft. 6 in.; blade area, 120 sq ft , disk area, 1,295 sq ft , gross weight, 2,400 lb , useful load, 780 lb

The Aeronca C-3 as a seaplane

ALTHOUGH the Aeronca C-3 has been licensed on Edo floats for over a year, production has just recently started on the Model 1070 float for this machine out at the College Point, L I , plant of Edo Aircraft. Several ships of this type have recently been delivered and Mr George B Post, vice-president of the Edo Aircraft, flew one with a passenger in a recent Aviation Country Club seaplane cruise. He reported making one leg of the flight covering 250 miles on less than 11 gal of gasoline at an average of 70 m p h

Floats for the Byrd Curtiss-Wright Condor under construction by Edo Aircraft Corporation.

Giant floats for Admiral Byrd's Condor

A 30-FT BOAT of any kind is no small craft, yet the over-all length of each of the pair of floats now under construction at the plant of Edo Aircraft, for use on Admiral Byrd's Antarctic Condor (see page 329) exceeds that dimension by 2 ft. 4 in. Designed for a ship of a gross weight of approximately 17,000 lb , each float has a submerged displacement of 16,800 lb They are the largest aircraft floats ever to be constructed in the United States, and possibly in the world. The beam of 57 in , and the height (maximum) of slightly over 45 in., makes it possible for mechanics to enter each of the eleven water-tight compartments for inspection through manhole covers

As usual with Edo floats, 17 ST Alclad sheets are used for the skin, and 17 ST extruded sections for internal structural parts. Due to the immense size of these floats, however the keelsons and sister keelsons which generally consist of simple flanged or extruded sections, have been replaced by I-beams built up of sheet metal webs with extruded flanges riveted together At the step, these girders reach a maximum depth of about 5 in An innovation was the extension of the flutes, usually found only on the forward bottom, to the afterbottom This arrangement not only secures improved hydrodynamic efficiency, but makes for added rigidity and an appreciable saving in weight. The total weight of each float (including 40 lb for water rudders) is 710 lb The entire float gear, complete with attachments, weighs 1,700 lb

THE BUYERS' LOG BOOK

AVIATION'S *Card Index of New Equipment*

This department is equipped to help readers locate manufacturers of any parts, accessories or materials

AIRPLANE ACCESSORIES — **Flexible control**

Brewster Aeronautical Corporation,
Brewster Building, Long Island City, N Y

SIMMONDS-BREWSTER Control System is a device to replace push rods, pulleys and cables in airplane flying or engine controls Flexible, almost frictionless,—the tube casing may be bent and led through any complicated structure. End fittings of all types available. Easily adjustable, no backlash, minimum maintenance Considerable savings reported in installation cost and weight.

AVIATION, *October, 1933*

AIRPORT EQUIPMENT — **Fire fighting**

Pyrene Manufacturing Company,
560 Belmont Avenue, Newark, N. J

THE Phomene Hopper is a device to be inserted in a hose line to produce a continuous stream of fire-blanketing foam from a water supply When coupled to a fire line, water enters one side, Phomene Hopper Powder is poured into the top, and the foam discharges back into the line No levers, valves or other moving parts Light enough (42 lb) to be carried by hand.

AVIATION, *October, 1933*

AIRPORT EQUIPMENT — **Photo-electric relay**

G-M Laboratories, Inc ,
1731-35 Belmont Avenue, Chicago, Ill

PHOTO ELECTRIC relay for operation of airway and airport beacons, obstruction lights, etc , in remote locations not served by power lines Requires no external voltage, is self contained, and operates without amplification Complete FSE relay unit incorporates Visitron F2 cell, a sensitive relay, and magnetic relay in cast aluminum case 6$\frac{1}{2}$x5$\frac{9}{16}$x4 in

AVIATION, *October, 1933*

MATERIALS — **Flux, welding, aluminum**

The Linde Air Products Company,
30 East 42d Street, New York, N Y.

A UNIVERSAL welding flux to be used with pure aluminum and with the usual aluminum alloys is offered to replace the two separate types of flux previously marketed. The new material is marketed in $\frac{1}{2}$-lb glass jars with screw tops which are, in turn, packed in individual cardboard cartons for protection against breakage in shipment.

AVIATION, *October, 1933*

PARTS — **Thumb screws, cold forged**

Parker-Kalon Corporation,
200 Varick Street, New York, N. Y.

A SERIES of cold forged thumb screws has been added to the Parker Kalon line of fastening devices The thumb pieces are shaped to fit the normal grip, and are knurled to prevent slippage. Screws are smooth, and free of burrs and will take plated finishes The threads are rolled on to close tolerances Stock sizes are available from $\frac{5}{16}$-24x$\frac{1}{2}$ in to $\frac{3}{8}$-16x3 in

AVIATION, *October, 1933*

RADIO — **Remote control system**

Westport Manufacturing Company,
Glendale, Cal.

NEW remote control mechanism announced for Westport radio receivers Reduction gears employed at both control and receiver end to eliminate backlash. Unit consists of aluminum control box and dial, tachometer cable, and reduction box. Control box arranged for either right or left hand mounting in cockpit. Volume control through potentiometer electrically connected to receiver.

AVIATION, *October, 1933*

SHOP EQUIPMENT — **Light, midget portable**

Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

A MINIATURE spot light for close examination of small and intricate machine parts without disassembly has been developed from the fountain-pen type flash light Attached to a flexible cord and a swinging arm, the light may be mounted over a work or inspection bench within easy reach Can be swung out of way when not in use. Operates from light circuit through transformer

AVIATION, *October, 1933*

SHOP EQUIPMENT — **Portable sander**

Porter-Cable Machine Company,
Syracuse, N. Y.

NEW Model T-3 Take-About belt sander incorporates a number of improvements over earlier models. Machine simplified by elimination of dust collection feature New arrangement of motor improves balance and reduces fatigue Aluminum construction reduced weight to 15 lb. Ball bearings are extensively used, and the entire machine is enclosed Standard 3x24-in belt fitted

AVIATION, *October, 1933*

COMMANDER FRANK M. HAWKS TELLS ABOUT HIS LATEST PLANE

THE TEXACO SKY CHIEF EMBODIES MANY NEW DEVELOPMENTS

The Texas Company has for many years been one of the outstanding leaders in furthering the practical development of the airplane and the application of safe speed to commercial air transport. This latter was one of the principal objectives in working out the details of the latest ship, the Texaco Sky Chief, which made the non-stop record of 13 hours and 27 minutes from coast to coast.

The Texaco Sky Chief embodies a number of new features which, though not radical, give a marked increase in the efficiency of the craft with respect to speed, weight and low landing speed.

The use of lighter alloys, light construction and a very large fillet provided strength as well as lighter weight. The Sky Chief carries a load greater than its own weight. The large fillet also adds considerable strength between wing stub and fuselage and greatly increased speed.

Landing speed reduced

Split trailing-edge flaps covering about 20% of the bottom chord of the wing have made it possible to reduce the landing speed to 40 m.p.h. with a light load and not over 55 m.p.h. with the full gross load of 7,500 lbs. They have reduced the take-off run approximately 30% when extended downward between 15 and 20 degrees.

New engine features

A special development of the 14-cylinder, double-row geared motor made it possible to add considerably to the plane's speed. The overall diameter of the fuselage is held down to 45 inches—the diameter of the motor. This thin fuselage, with the rather large wing surfaces, of about 263 sq. ft. and the use of controllable-pitch propeller and proper super-charging, gave very greatly increased power possibilities at higher altitudes.

Top speed at 7,000 ft. with the motor developing 730 h.p. is, at present, 248 m.p.h. The cruising radius at 85% power, operating at 220 m.p.h. is 2,500 miles. The plane can fly as slowly as 70 miles per hr.

Special robot pilot

A robot pilot of unusual, though simple, design has been very satisfactory. It weighs but 25 lbs. A compound pendulum and compass, actuating through low pressure vacuum, controls the Sky Chief on all its axes. On the 2,240 mile coast-to-coast flight, this highly successful little robot helper had full charge of the plane for over 1,500 miles.

Unusual radio equipment

The radio equipment is especially noteworthy. The receiver is a four-tube "super-het" with switch arrangements to permit reception of code signals as well as voice. It is extremely sensitive and uses a very small amount of power. Suitable radio direction finders will shortly be installed for accurate radio navigation in any part of the world. Two of the tubes are hooked up for double duty; giving the power and sensitivity of a 6-tube set, with only four tubes actually employed. The complete installation, including battery, weighs only 7 lbs.

The transmitter utilizes a trailing antenna of quarter wave length, tuned by its actual length for each frequency employed. Power is secured from the ship's 12-volt battery, through a motor driven Eclipse generator. It is an interesting fact that with quite a limited amount of power, the station having only a 50-watt transmitter, there is actually some 45 to 48 watts emitted from the antenna itself, which is a very high degree of efficiency. The power arrangement of the radio hook up also permits very favorable operation on the ground with the antenna run out to any nearby tree or pole. A pilot on a forced landing could transmit signals for a period of approximately four hours before the battery would become affected.

The instrument board

The board is exceptionally well laid out for ease in operation, especially when flying blind. The compass is mounted directly in line with the pilot's eyes. The complete night flying installation includes an interesting landing light fitted into the leading edge of the wing and conforming to the contour. In the event of a forced landing there are five one-minute flares mounted on the head rest and operated electrically.

Texaco Aviation Gasoline Texaco Airplane Oil

Nothing but Texaco Aviation Gasoline has been used in the new ship because it has been found to give exceptionally uniform and satisfying performance. Texaco Airplane Oil is the only oil that has been circulated through the motor. It is interesting to note that there has been no appreciable wear whatsoever. This fine performance gives testimony to the excellent qualities of Texaco Aviation Gasoline and Texaco Airplane Oils in our service.

THE TEXAS COMPANY, *135 East 42nd Street New York City*

TEXACO

Well done NAVY!

....Your 2,059-Mile, Non-Stop Overseas Formation Flight Has Established a New World's Record

THE U. S. NAVY FLIGHT from Norfolk, Virginia, to Coco Solo, Panama, Canal Zone—a distance of 2,059 statute miles—set a new world's record by accomplishing the longest non-stop formation flight in the history of Aviation. It exceeded by over 195 miles the previous mark set in 1931 by General Italo Balbo and his squadron, on their flight from Italy to Brazil.

Lieutenant-Commander D. M. Carpenter, USN, commanded the squadron, which consisted of six long-range, Consolidated Flying Boats, each powered by two Wright Cyclone Engines. The flight encountered almost every conceivable weather condition—including headwinds that registered a velocity of over 50 miles an hour. The "Cyclones" functioned perfectly throughout the 25 hours of gruelling flight.

Official commendation upon the success of the flight was extended to the Navy Department by the President of the United States, who stated that the flight evidenced the efficiency of Naval Aviation. Wright Aeronautical Corporation is as proud as the Navy of this splendid achievement.

NRA

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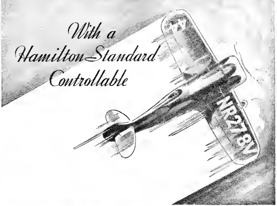
BOEING *has always built tomorrow's airplanes today!*

World's Fastest Land Plane



The Hamilton Standard Controllable is simple in operation and rugged in construction. Hydraulic operation in conjunction with centrifugal counterweights insures smooth, positive action in changing the pitch at will to meet the conditions of take-off or extended flight.

Averaging 305.33 miles per hour for four runs over an official 3-kilometer course, James R. Wedell established a new world's speed record* for land planes at Chicago on September 4. His plane was a Wasp-powered Wedell-Williams Special, equipped with a two-bladed Hamilton Standard Controllable Pitch Propeller—the controllable that has proved its dependability in the day-by-day service of the world's leading air lines. *Record subject to official confirmation.

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1. *Warner and Johnston's—*
AVIATION HANDBOOK $7.50

This book brings together under one cover a great volume of valuable reference detail for the aeronautical engineer, designer and draftsman. From many authoritative sources some of them not otherwise generally available, have been gathered up-to-date and constantly useful information on the theory of heavier-than-air craft, materials and their properties, drawings and weight information on standard parts, installation data on engines and other large units, formulas, useful structural data, etc.

2. *Chatfield and Taylor—*
THE AIRPLANE AND ITS ENGINE—New Second Edition $3.00

Intended primarily for the reader who desires a sound knowledge of the basic principles and a broad view of the present development of the airplane and its power plant. No material is introduced which requires more than an elementary knowledge of physics or mathematics for its understanding. The discussion of the fundamental principles, construction and capabilities of the airplane and its engine are presented in simple form and adequately illustrated.

3. *Younger—*
AIRPLANE CONSTRUCTION and REPAIR $3.00

This book gives in convenient form fundamental material for complete training in the duties of an airplane mechanic. It presents problems and experiments for practical applications and for study of the basic concepts. The experiments are simple in character and may be performed with the ordinary equipment of the average shop.

4. *Weems—*
AIR NAVIGATION $5.00

In this textbook a special effort has been made to include the material necessary to round out the beginner into a practical air navigator. The book covers pilotage (or map reading), dead reckoning, aerology, radio position finding, and celestial navigation. The discussion of celestial navigation includes a description of new, efficient and novel methods and equipment not heretofore included in any text on air navigation.

5. *Reid—*
APPLIED WING THEORY $3.00

The first book in English to present a comprehensive treatment of the theory of aerodynamic induction, wing profile theory and their applications, in a form which can be readily followed by engineers and students. The fundamental material is amply supported by experimental evidence and supplemented by helpful mechanical and electrical analogies.

6. *Maguire—*
AEROLOGY $2.50

This book presents a brief but accurate, non-mathematical discussion of the atmosphere. Its purpose is to tell the aviator how the weatherman works, how to interpret the weather phenomena the pilot sees around him, and how best use may be made of the reports, advices and forecasts now made available.

7. *Holland—*
AVIGATION $2.50

This book is planned as a textbook for airmen preparing for the Transport Pilot's Examination, and as a text and reference book in air piloting for the practical avigator. It covers air piloting, dead reckoning, radio avigation and astronomical avigation fully and gives a complete outline of avigation procedure. The book was written with Department of Commerce requirements and United States Army and Navy practice kept in mind.

8. *Miller—*
THE AIRCRAFT MECHANICS' HANDBOOK $2.00

This book covers all the data, information and methods that the mechanic needs in order to handle the work of airplane maintenance and repair in accordance with the highest standards. The book is written in easy, progressive and concise form and tells what tools are necessary and how to use them—describes the materials of airplane construction and how to handle them—gives methods for the repair of all parts of the aircraft and engine—describes inspection methods thoroughly, etc.

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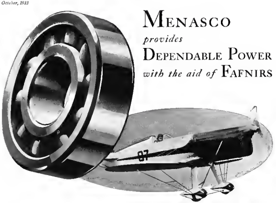

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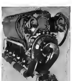

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